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Biological Collections at the University of California, Davis: Scope, Status, and Needs

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Scope, Status, and Needs

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Davis, California

This report is published by the University of California Genetic Resources Conservation Program as part of the public information function of the Program. The Program sponsors projects in the collection, inventory, maintenance, preservation, and utilization of genetic resources important for the State of California as well as research and education in conservation biology. These activities take place on the several campuses of the University of California with funds provided by the State of California to the University.

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PREFACE

The integrity of biological diversity on a global basis is being steadily degraded. Attempts to reverse this trend are small and scattered. The scope of the problem is not adequately defined because a global bioinventory has not been completed; even highly developed areas such as California lack adequate bioinventories. The conservation of biodiversity depends upon detailed knowledge of taxa, including their geographic distribution and evolutionary relationships. Biological resources are the essential element in sustaining the human population's needs for food and fiber. Exploitation of these resources is both promotive and contrary to their conservation. Certainly, a goal is to conserve biological resources in their native habitats so they can continue to evolve and be mutually supportive in complex ecosystems. This is not possible in some instances and, in any case, representatives of species should be readily accessible for use in research and commerce. Thus, we are concerned about living and preserved collections of biological materials. Each research institution must develop specific collections as it pursues research goals. These collections, taken nationally and internationally, form a network of materials, curated by experts, which underpins the solution to the biodiversity crisis. The network is informal, but generally collegial with free interchange and sharing of museum specimens, living organisms, and cloned DNA.

The Davis campus of the University of California has a long history of research on many types of organisms. World-class collections have evolved and are maintained in various states of security. Some important collections have been orphaned by retirement of faculty members. A few of these collections have been transferred and others destroyed. This is not a local issue; it occurs throughout the US and represents the silent crisis in biodiversity conservation. Solutions must be sought and several suggestions have been made to reverse this trend. At a recent symposium*, I suggested that a national endowment be established comparable to the one for humanities to provide support for perpetual conservation of biological resources. A National Institutes for the Environment is being proposed which promises to address biological resources. Thus, there are ways to mitigate

* Qualset, C.O. 1990. Conservation of biological resources: A proposal for sharing the responsibility. *In:* McGuire, P.E. and C.O. Qualset (eds.) Genetic resources at risk: Scientific issues, technologies, and funding policies. Report No. 5. University of California Genetic Resources Conservation Program, Davis, CA.

the problem. The means by which to do this are less clear. Certainly conservation activities are a small portion of total research expenses and are minuscule in comparison to costs of operating a large physical plant such as a university or institute campus. Priorities must be adjusted. Beyond that, however, is a diminishing base of trained professionals who can address biological identities and relationships. University biological collections are vital for education of young scientists entering the field of biological conservation.

This report calls attention to a vast wealth of biological materials held on a single research campus. It was developed as a responsibility of the University-wide Genetic Resources Conservation Program (GRCP). A goal of GRCP has been to identify genetic resources important to California. Since the Program's inception in 1985, a small-grants program has provided small, but critical financial support to endangered collections of genetic resources. By means of this grants program and through the activities of the UC Davis Association of Biological Collections, we learned of many varied collections on the UC Davis campus. As a first step in a campus-by-campus survey to determine the extent of the University's holdings, we conducted a comprehensive survey on the Davis campus.

Marilyn Warburton, a graduate student in genetics in the UC Davis Department of Pomology, was hired to conduct telephone and in-person interviews. She very diligently followed leads to curators, managers, researchers, and others responsible for collections, to assemble the information that is summarized here. This approach was more successful than previous mail surveys. However, as with any survey effort, there are some potential respondents who were never reached and others, though contacted, did not provide sufficient information, so their collections could not be included. Therefore, we emphasize that the inventory and analysis of campus collections presented here, as impressive as it is, is still incomplete.

A broad-based task force, chaired by Lynn Kimsey of the Department of Entomology and Director of the Bohart Entomological Museum, was convened to review and assess the status of living and preserved biological collections held on the Davis campus. The task force addressed three basic issues and formed subcommittees to 1) review the survey data and draft this report; 2) make recommendations for policy guidelines on a campus basis and an individual-collection basis, and 3) propose a campus-wide administrative structure to address issues of communication, documentation, and funding. Policy for administration, ownership, transfer, and disposal of collections has not been previously addressed by the University of California. The task force's recommendations on these issues are the subject of a separate report.

The issue of communications pervades all aspects of utility, value, support, and documentation of biological collections. We found instances in which departmental administrators were not aware of collections in their purview. In some cases, a person responsible for a collection in one department was not aware of similar holdings in a collection of another de-

partment. The campus administration as a whole has not been aware of the cumulative extent and value of the role played by biological collections in campus research, education, and service activities. It is our hope that this report is a step in the direction of remedy for this situation. This report demonstrates the vast diversity of living and preserved biological collections vital to the University of California, Davis campus. The campus community can acknowledge these collections with as much pride as it does the scientific and educational achievements that the collections have enabled.

It is a pleasure to acknowledge the outstanding work of the task force. Especially, the persistent efforts of Marilyn Warburton were necessary to assemble the data presented in this report. Pat McGuire lent his organizational and editorial skills to keep the effort intact and to bring it to a conclusion. The cooperation of the faculty and curators in developing this report was generally outstanding. We hope their collections are adequately represented. GRCP urges responses with additions and corrections that may be included in the data.

Calvin O. Qualset, Director
Genetic Resources Conservation Program

TASK FORCE MEMBERSHIP

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Roger Chetelat[b]	Vegetable Crops
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Marilyn L. Warburton[b]	Pomology
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Members of the Administrative Structure subcommittee are denoted by superscript *a*, those of the Collections subcommittee by superscript *b*, and those of the Policy subcommittee by *c*. Chairs of these subcommittees are indicated by an asterisk.

EXECUTIVE SUMMARY

The rich heritage of agricultural and biological research and teaching on the Davis campus of the University of California is reflected in its vast holdings of scientific collections of living and nonliving preserved biological materials. More recently, as the campus expanded, important collections were developed to support research and educational programs in human and veterinary medicine, anthropology, and geology. A task force reviewed the results of campus-wide surveys and reports the following findings:

- Eighty-five collections of living entities and 17 collections of preserved biological materials or nonliving entities including anthropological and geological materials are maintained in 21 departments of the Colleges of Agricultural and Environmental Sciences and Letters and Science and the Schools of Medicine and Veterinary Medicine. In addition to academic departments, holdings of state, national, and international interest are in the Davis Arboretum, the Foundation Plant Materials Service, the Bodega Marine Laboratory, the Animal Resources Service, the California Primate Research Center, and the USDA National Germplasm Repository for Fruit and Nut Crops. The total number of accessions included in all these collections is in the millions.

- The collections are unique, irreplaceable resources which must be maintained as a vital element for teaching and research. They provide a valuable historical and documentation base for studies on biological diversity and the effects of human influence on the biota of California and elsewhere.

- As a teaching resource, the collections are used in more than 170 undergraduate and graduate courses.

- Some valuable collections, developed at Davis, have been lost to the campus as a result of abandonment upon retirement of a curator or transfer to another site.

- Documentation of campus collections is a dynamic process. New faculty and new research interests lead to the evolution of new collections. New technologies mean that new materials will be amassed with concomitant new maintenance challenges.

- The documented annual campus-wide investment in maintenance of departmental collections is rather small, less than $2 million, while larger

nondepartmental collections require considerably more funds. University and extramural grant funds are both important in the maintenance of collections.

- The large holdings at Davis are a "silent resource" because of the little publicity given to the collections. No campus registry nor budgetary provision is maintained to secure these valuable resources. Computer-based inventories do not exist for many of the collections and many are not linked nationally and internationally by electronic mail.
- The continued accessibility, growth, and utility of the majority of campus biological collections are subject to constraints of inadequate funding for supplies and personnel, inadequate space and facilities for maintenance, retirement of key personnel, changing administrative responsibilities, and inadequate documentation, duplication, and backup.
- Forty-two percent of the living collections are considered at risk, while none of the preserved collections are so considered. However, almost all collections face some limitation precluding optimum maintenance. Inadequate funding was cited for 64 % of the collections, inadequate space was cited for 47 %, inadequate departmental interest was cited for 7 % , and retirement of key personnel was cited for 4 %. Twelve collections are maintained by emeritus faculty members.

Based on these findings, the following recommendations are offered:

- There should be a campus-wide registration of biological collections as resources for the research, teaching, and service activities of the campus, and a campus database of collections should be established.
- As a means of official recognition of collections, there should be a framework for communication between departments and between schools and colleges about issues of documentation, distribution, and disposal.
- The campus administration should actively work with the individual units that administer collections to ensure secure and sufficient funding for the continued maintenance of these vital resources.
- Cost-saving measures might be achieved by interdepartmental management of collections with similar requirements, coordinated and shared inventory procedures, uniform fee accounting (for collection where usage fees are applicable), and sharing of backup facilities where similar requirements would permit. Enhanced campus-wide communication would facilitate the identification and implementation of such measures.
- Campus- or University-wide policies regarding ownership, transfer or disposal, and user fees should be established.

INTRODUCTION

Since its founding, the Davis campus of the University of California has been active in diverse fields of science. The focus of this report is on the biological collections developed and maintained on this campus. Much of the University's research, teaching, and service activity is devoted to biological organisms and their environments. Objectives of such activities include quality food production, maintenance of plant and animal health, determining the impact on biological diversity of global environmental change, and understanding the role of biodiversity in the world's ecology and for human aesthetics. The biological collections housed on the Davis campus are a vital resource for the agricultural, anthropological, biological, cultural, environmental, medical, and veterinary sciences. For the most part, these collections are irreplaceable.

This report is an attempt to determine the status of the biological collections that serve the campus. The information on the identity and size of the campus collections was provided by four surveys. The first and second surveys, 12 years apart, were carried out and published[1] by the campus Association of Biological Collections (ABC) under the direction of Robert O. Schuster, then-curator of the Bohart Entomological Museum on the UC Davis campus. The earlier one (1976) did not cover living collections. The third listing was done in 1990, also initiated by the ABC, this time directed by Lynn Kimsey. The fourth was conducted by Genetic Resources Conservation Program and emphasized living collections. As a result of these efforts, some 100 living or preserved collections of organisms and related materials have been identified. These collections cover the taxonomic spectrum, from viruses and bacteria to grapevines, fruit flies, fish, birds, and mammals. The vast majority of the collections have been founded by single individuals or research groups, without any campus-wide coordination or special sources of funding. Some of the campus collections have grown to great size as researchers have added to the ever-growing knowledge base of organismic diversity. Some collections contain large proportions of the known diversity in given geographic areas.

The surveys identified 85 collections of living materials and 17 collections of nonliving or preserved materials (Table 1 and Appendix 1).

[1] Anon. 1976. Systematics collections of the Univ. of Calif. at Davis. Association of Systematics Collections Newsletter. 4(4):41-42 *and*
Anon. 1988. University of California—Davis. Association of Systematics Collections Newsletter. 16(4):6-7.

Twenty-one campus academic departments have at least one collection. There are also five other administrative units that maintain collections: the Davis Arboretum, the Foundation Plant Materials Service, the Bodega Marine Laboratory, the Animal Resources Service, and the California Primate Research Center. The campus is also the site of a unit of the US Department of Agriculture National Plant Germplasm System: the National Germplasm Repository for Fruit and Nut Crops, which maintains a living collection of germplasm accessible to campus researchers.

The diversity of the biological collections on the Davis campus is important not only for reasons of aesthetics and scientific curiosity, but because human existence depends on the biological resources of the earth. The current wave of extinction is destroying both known biotic resources and those still undiscovered. Up to the present time, scientists have col-

Table 1. Administrative units responsible for campus biological collections.

	Living	Preserved	Total
	(Number of collections)		
College of Agric. & Env. Sciences	**64**	**6**	**70**
Agronomy and Range Science	12	0	12
Agr. & Range Sci./Student Farm	1	0	1
Animal Science	3	0	3
Avian Sciences	5	0	5
Entomology	5	2	7
Environmental Horticulture	6	1	7
Food Science and Technology	2	0	2
Nematology	2	2	4
Plant Pathology	10	0	10
Pomology	10	0	10
Vegetable Crops	5	0	5
Viticulture and Enology	3	0	3
Wildlife and Fisheries Biology	0	1	1
College of Letters & Science	**0**	**4**	**4**
Anthropology	0	3	3
Geology	0	1	1
Division of Biological Sciences*	**12**	**4**	**16**
Botany	5	3	8
Genetics	4	0	4
Microbiology	2	0	2
Zoology	1	1	2
School of Medicine	**1**	**0**	**1**
Microbiology and Immunology	1	0	1
School of Veterinary Medicine	**4**	**2**	**6**
Animal Resources Service	1	0	1
California Primate Research Center	1	1	2
Microbiology and Immunology	0	1	1
Reproduction	2	0	2
Bodega Marine Laboratory	**1**	**1**	**2**
Foundation Plant Materials Service	**1**	**0**	**1**
Davis Arboretum	**1**	**0**	**1**
National Germplasm Repository	**1**	**0**	**1**
Total	**85**	**17**	**102**

* These collections listed for the Division are the joint responsibility of the Colleges of Agricultural & Environmental Sciences and Letters & Science.

lected and named only about 1.4 million species. Estimating by extrapolation, the total number of currently extant species is probably somewhere around 50 million. The US National Science Board has recently recommended the completion of a global biological inventory[2]. The Board states: "This is urgent; without a reversal in current rates of habitat destruction and species extinction, a comprehensive systematic survey will be possible only for the next 10 to 20 years." Many of the biological collections at UC Davis could serve as baseline references and diagnostic tools in critical bioinventories at both national and international levels.

ROLE OF COLLECTIONS AT THE UNIVERSITY

I. Support of teaching.

Specimens from 64 collections (Table 2) are used in support of more than 170 courses in basic biology of organisms: morphology, physiology, and anatomy; relationships among organisms: taxonomy, systematics, ecology, evolution, and pest management and control; production systems for human use of organisms; human cultural history and prehistory; biological history: archaeology and paleontology; genetic, medical, and veterinary protocols and procedures; and aesthetic human endeavors: art and design. Appendix 2 lists the presently documented campus courses utilizing collections.

Table 2. Use and management of campus biological collections.

	Living	Preserved	Total
	(Number of collections)		
Used for:			
Research only	25	1	26
Teaching only	1	1	2
Service only	2	0	2
Research and Teaching	28	4	32
Research and Service	7	0	7
Teaching and Service	0	2	2
Research, Teaching, and Service	19	9	28
Not in use	3	0	3
Managed by:			
Faculty	74	10	84
Retired faculty	11	1	12
Staff	10	6	16

II. Repositories of history and information.

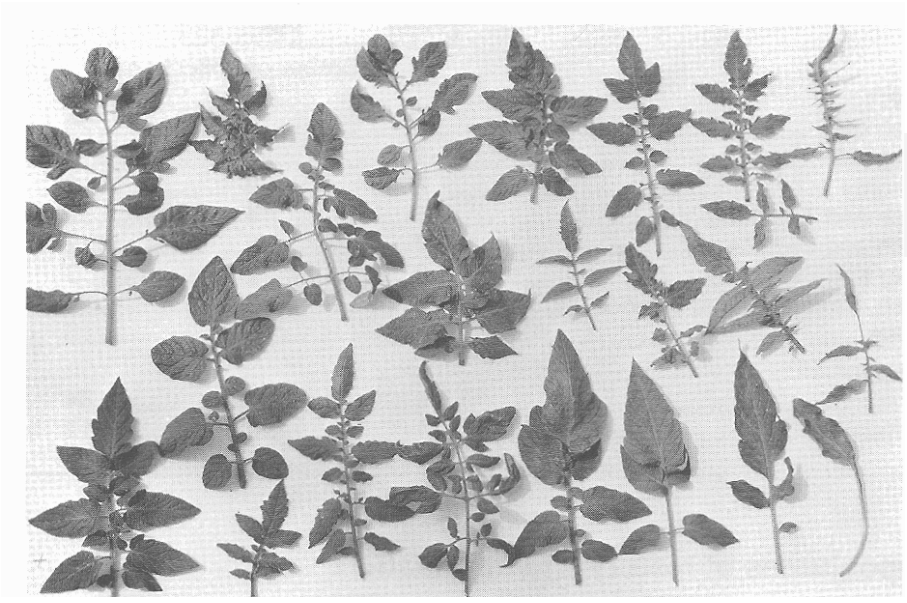
Campus collections provide readily accessible documentation of biodiversity, human culture, taxonomic and ecological relationships, and research and survey voucher specimens. Increasingly, collections are becoming the

[2]Committee on International Science's Task Force on Global Biodiversity. 1989. Loss of biological diversity: A global crisis requiring international solutions. National Science Board Report NSB-89-171. National Science Foundation, Washington, DC.

last repository of many organisms threatened with extinction. Many of the Davis collections function as national and international repositories for use as reference and diagnostic services, which often involves lending and documentation activities. Twenty-six living collections and 11 preserved collections have been identified as having such a service role (Table 2). These collections are consulted by scientists from other academic institutions and government agencies for environmental impact reports, investigations on rare and endangered species, for identifications of weeds, toxic organisms, and unknown specimens, and for legal issues with respect to patented organisms and processes. Preservation of voucher specimens for research and patented organisms is becoming an increasingly important role for many collections. Most research collections distribute material on request on an informal basis while many of the systematic and service collections loan and distribute material on a formal basis, often with a fee structure to offset partially the obvious constraints of demand, shipping regulations and costs, and personnel to handle the distribution.

III. Resources for research.

Campus biological collections provide the tools for studies and predictions of impacts of disturbances on species, ecological communities and the environment; for studies of evolutionary processes and genetics; for improvement of plants and animals; and for studies on biological diversity itself. Ninety-three collections were identified as being used for research (Table 2). Over 100 faculty and staff members have managerial or curatorial roles with collections (Table 2), attesting to the widespread and diverse involvement with collections by campus personnel. The collections are used in research at all levels of biological organization from DNA to the ecosystem. In particular, the efficiency and productivity of California agriculture has depended heavily on collections of organisms assembled and maintained by researchers at UC Davis



Genetic stocks consist of organisms that carry one or more defined genes. These may be defined or recognized by morphology, by biochemical diagnoses, or by their specific nucleotide sequences. Such stocks may be found opportunistically, created by DNA manipulation, or induced by mutagens. Shown here are mutant genotypes, revealed by variant leaf morphology, induced by treatment of cultivated tomato by the mutagen EMS. These lines are part of the C.M. Rick Tomato Genetics Resource Center in the Vegetable Crops Department.

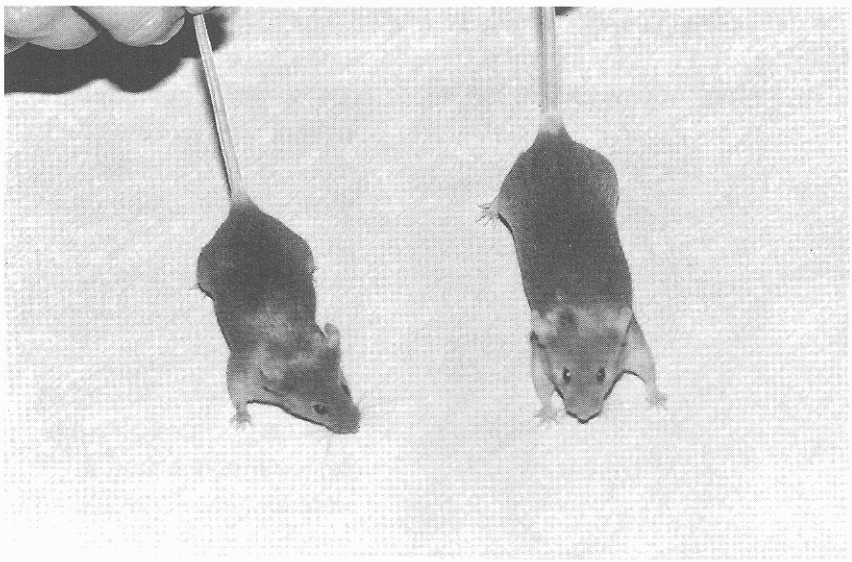
SCOPE OF CAMPUS COLLECTIONS

Summary listings of 85 living and 17 preserved biological collections are provided in the Appendix 1. The actual number of collections on campus is larger, since there are additional collections not identified by the recent surveys. Several campus collections are highlighted in the following pages to illustrate the diversity and breadth of UC Davis collections and the extent of the investment of time and money that the collections represent.

I. Living collections

Animal collections. Almost every campus department that deals with animals maintains one or more teaching and research collections ranging from whole animals representing populations, breeds, inbred lines, mutant stocks, or genetic and chromosomal stocks to collections of living tissue, serum, cells, gametes, and embryos. The species represented include domesticated and harvested species, such as sheep, poultry, and fish; laboratory animals, such as mice and fruit flies; and wild vertebrate and invertebrate animals.

Cryopreservation, the maintenance of gametes, embryos, or tissue at extremely low temperatures, offers a means of storage of biological resources that avoids the problems and costs of maintaining large herds or colonies, provides a means of freeing stocks of diseases, provides a means of backing up collections maintained as living animals, and facilitates distribution of germplasm to other researchers. However, the procedures involved in freezing, storing, and successfully thawing and utilizing the once-frozen material must be optimized for each species for which it is attempted. In the Department of Animal Science, there has been success in using cryopreservation with genetic stocks of sheep from long-term selection programs and widely used genetic lines of mice, important for physiology and endocrinology research.



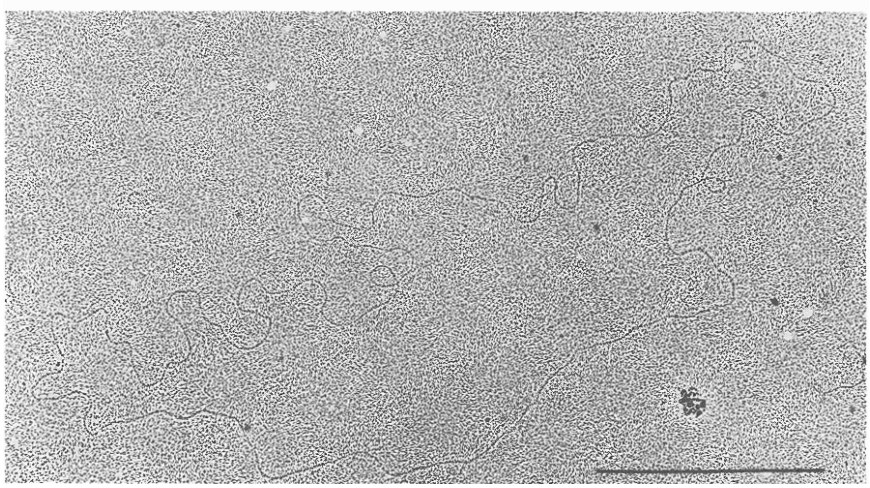
Cryopreservation of embryos is becoming increasingly useful as a means of maintaining genetic stocks of animals. It requires the development of successful procedures of obtaining, freezing, thawing, and implanting the embryos while maintaining viability of the donors, embryos, and recipients. Shown here are two mice from the same litter. The individual on the right is homozygous for a mutant gene (*hg hg*) which increases growth rate 50%. This mutation occurred in a UCD research stock in the Department of Animal Science and has never been reported elsewhere. The mutation has been backcrossed into an inbred line. Embryos from the original stock and the *hg hg* inbred line have been frozen to ensure preservation of the mutation which is being used extensively in studies of genetics and physiology of growth.

In the Department of Avian Sciences, experimental inbred lines, mutants, and congenic lines of chicken and turkey are being successfully maintained by cryopreservation.

Colonies of cockatiels and orange-winged Amazon parrots are also being maintained in the Department of Avian Sciences. Here the collections are used in research on the nutrition, reproductive behavior and physiology, and management of parrots. Information from this research can be extended to attempts to aid and manage threatened and endangered species of parrots without further impacting them by the collection of animals for research. The collections also serve teaching and outreach projects such as the Psittacine Research Project for which department member James Millam is faculty advisor.

At the Bodega Marine Laboratory, living populations of species of oyster are maintained for pedigree analysis, breeding, and study of genetic diversity. This collection facilitates breeding research that benefits commercial oyster culture, the largest marine aquaculture industry in California, and research on the physiology and genetics of the organisms.

Microbe, alga, fungus, virus, or DNA collections. Several departments maintain collections of plant or animal pathogenic bacteria, fungi, protozoans, or viruses necessary to investigate the control of the diseases they produce and as screening agents in breeding programs. The arena of molecular biology research has provided new uses for bacteria and virus collections. Bacteria are increasingly being used as sources of the enzymes useful to molecular biology. Especially important are bacteria that occur naturally in extreme environments, emphasizing the importance of well-documented collections. In addition to their role as pathogens, viruses also serve as tools of molecular biology as carriers of DNA from one organism to another and as subjects for basic research in genetics. Departments that carry out molecular biology have found it necessary to assemble and maintain collections of bacteria, viruses, and libraries of DNA, RNA, and gene constructs to facilitate research. Not all of these rapidly developing collections have been listed here.



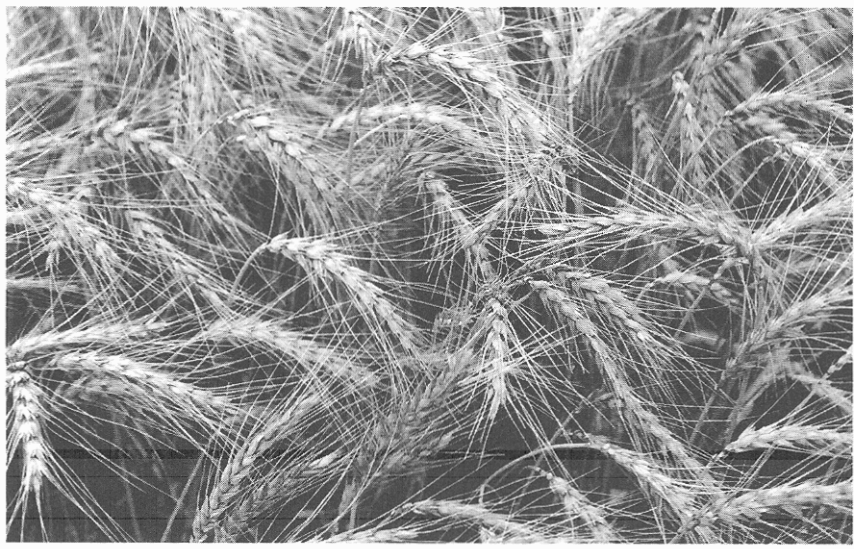
New biotechnologies make possible the study, isolation, creation, use and maintenance of novel biological materials. An example is the tartrate catabolic plasmid pTAR (44 kilobases) from the collection of Clarence Kado in the Department of Plant Pathology, revealed here by electron microscopy. Plasmids replicate autonomously within host bacterial cells and can be transferred from one organism to another either genetically or physically. Any gene may be inserted into plasmids, which can be amplified to produce useful proteins. Plasmids are used to engineer genetically plants and animals.

The Department of Botany has a collection of

400 species of freshwater green algae (orders Volvocales, Chlorococcales, and Zygnematales) and a collection of more than 12,000 single-spore research cultures of basidiomycete fungi (orders Tremellales and Auriculariales). These collections are the largest live collections of their kind in North America, and each represents the career's work of a campus professor. The algae collection also includes a number of liquid-preserved samples, herbarium sheets of east and west coast algae, and prepared diatom slides. The fungi collection consists of single-spore research cultures which are stored in liquid nitrogen. Nearly half of these cultures originated from worldwide collecting in Brazil, Panama, Romania, Germany, Russia, and western Canada or through exchange with other mycologists.

There is also a large collection of fermentation yeasts and bacteria in the Viticulture and Enology Department. It is the largest collection of its type in the world and is the only one in the United States, containing more than 500 individual yeast strains, 100 individual bacteria strains, and one mold. Yeast and bacteria strains from this collection have been especially valuable to California winemakers. The Yeast Culture Collection developed in the Department of Food Science and Technology has about 2,000 strains of yeast of known or potential uses in the beer, medicine, and technology industries. It was collected over 60 years by three faculty members, now all retired, from commercial and native foods and from plants in many environments throughout the world. Many could never be collected again.

Plant collections. Most plant-oriented departments maintain teaching and research collections of plants: accessions of wild species, populations, land races, cultivars, mutant stocks, genetic and chromosomal stocks maintained as whole plants, seed collections, material for vegetative propagation, and cell and tissue cultures. Represented are horticultural and agricultural crop species, wild native and introduced species, and wild species related to California crop species. The majority of these collections are maintained as seed or culture collections and are not readily visible on campus. Exceptions include the orchard and vineyard collections such as those of the Departments of Pomology and of Viticulture and Enology.



Basic research and genetic improvement of cereal crop species depend on accessible genetic stocks, chromosomal stocks, gene pools of wild species, and breeding lines. All of these are maintained in several collections in the Department of Agronomy and Range Science. Pictured here is the breadwheat cultivar Serra released from the wheat breeding program of C.O. Qualset in that department.

The collections of the Departments of

Agronomy and Range Science, Environmental Horticulture, Pomology, Vegetable Crops, and Viticulture and Enology are critical to the genetic improvement of a large number of the more-than-200 commercially important crops grown in the state. These same collections are also the foundations of successful research programs in basic biological processes and genetic mechanisms relevant to plant biology in general. The Charles M. Rick Tomato Genetics Resource Center in the Department of Vegetable Crops is an example of a collection that serves applied and basic research and is recognized nationally and internationally. Its holdings include genetic stocks carrying mutant and marker genes, lines perpetuating chromosomal variants, and accessions of wild species related to cultivated tomato that continue to be a resource for genes conferring disease and pest resistance[3]. The Center is supported by the University, the US Department of Agriculture, and an endowment fund being accumulated over the period 1991 to 1995 from contributions from individuals, corporate institutions, and research institutions that have used Rick Center materials directly or indirectly.

A landmark of the campus is the collection of plants maintained as the Davis Arboretum. This area serves as an outdoor classroom and living museum which supports the existing academic curriculum of the University. It is a library of plants enhanced by interpretive displays, pamphlets, and lecture tours. Special emphasis is placed on the development of the collection to illustrate the complete range of ecological situations found within the Central Valley and the California foothills. The Arboretum contains the largest collection of California native plants cultivated in the Central Valley of California and a collection of drought-tolerant Mediterranean plants. These gardens serve as an immense reservoir of information about landscape use of native and other locally adapted plants. The Davis Arboretum is intensively used for teaching and provides a campus location for a variety of field research projects.

The Botany Conservatory collection is a live collection of over 2,000 taxa, maintained primarily under greenhouse conditions with the dicot family Euphorbiaceae and the monocot family Marantaceae particularly well represented. The collection is especially rich in specimens from the floras of Socotra and Madagascar, and contains many examples of xerophytic and epiphytic adaptations. Much of this collection is irreplaceable. These plants are used for a wide diversity of research and teaching efforts, as well as for public exhibits.

II. Preserved collections

Anthropology collections. The Anthropology Department collections have developed, beginning with the formation of the department in 1960, as a result of faculty and graduate student research, the Archaeological Field

[3] Tomato Genetics Stock Center Task Force. 1988. Evaluation of the University of California Tomato Genetics Stock Center: Recommendations for its long-term management, funding, and facilities. Report No. 2. University of California Genetic Resources Conservation Program, Davis, CA.

School taught each summer, unsolicited items donated by the public, and purchases. The Department's holdings comprise three basic types of materials: archaeological, ethnographic, and biological, and are considered for the purposes of this inventory as three large "collections".

Archaeological: These materials comprise at least 350 groups of artifacts resulting from archaeological surveys and excavations of prehistoric sites primarily within California. Each group contains between 2 and 50,000 specimens, with an average of roughly 3,000. Other materials maintained in support of the archaeological program include: 1) a comparative skeletal collection of California fauna, 2) a comparative pollen collection, 3) obsidian hydration samples, and 4) a collection of California topographic maps with site locations.

Ethnographic: These materials comprise 63 groups that are global in nature, primarily including North American, African, Mesoamerican, and South American materials. Items range from artifacts used in daily life to made-for-sale folk art. Two thirds of this material have been collected by faculty. The remainder has been donated by the general public. The C. Hart Merriam North American Ethnographic Collection is the highlight of these collections. It was purchased by the University in 1963, and contains 1,337 baskets and 200 other miscellaneous items.

Biological: These materials comprise two groups maintained for teaching and research: the paleoprimatological/anthropological collection of casts of fossil primates and hominids and the nonhuman captive primate skeletal collection.

Many of the materials housed in the Anthropology Department are used and developed for teaching. Others, including the basket, archaeological, and fossil primate/hominid cast collections are invaluable for future research and as baseline and voucher specimens of current projects. The archaeological collections are important representations of the prehistory of central California and the eastern slope of the Sierra Nevada. The Merriam Ethnographic Collection is world renowned and unique in its extensive documentation of the western US (particularly California) basketry. The fossil primate/hominid cast collection contains nearly every known specimen excavated worldwide to date.

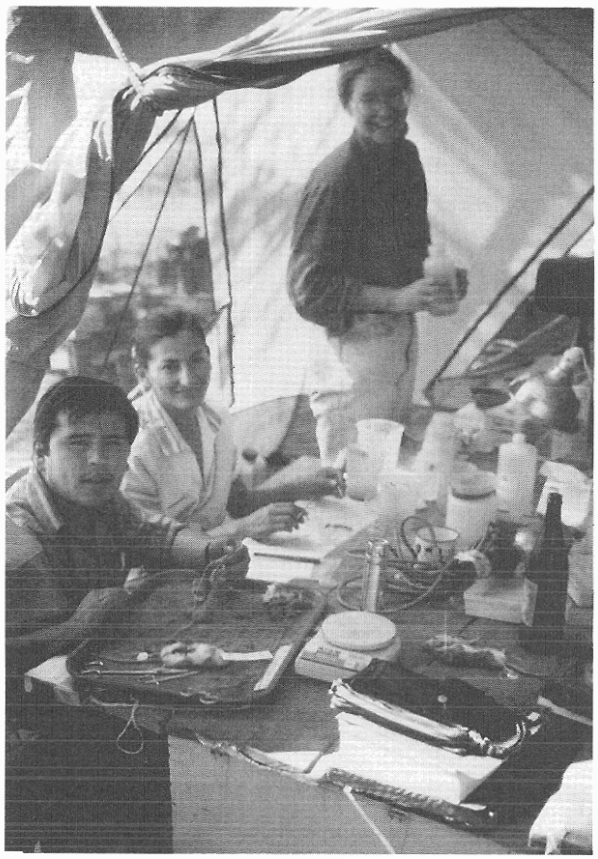
Bodega Marine Laboratory Collection. The collection at the Bodega Marine Laboratory (BML), located in the Bodega Marine Reserve in Sonoma County, originated from research performed at BML. Collected specimens serve as reference materials for classes and visiting researchers. It contains general specimens from the reserve including 20 marine mammals, 150 fish, 50 birds, 1,000 invertebrates, and 1,600 terrestrial and marine plants. This collection is invaluable as a research tool, for identification of organisms in the reserve, for systematic studies, for deposition of research voucher specimens, and for public education. There is no other collection so specifically representative of the habitats found in the Reserve.

Botanical collections. The John M. Tucker Herbarium in the Department of Botany was founded in 1922 and was officially named in 1986. It now includes the Beecher Crampton Range Plant Collection, transferred from the Agronomy and Range Science Department. The main Tucker collection contains more than 118,000 mounted specimens of primarily vascular plants, most of which are from California and adjacent regions of North America, including northern Mexico. There are also significant holdings from Latin America, the Caribbean Region, Australasia, and the Mediterranean Region. This collection has a unique emphasis on poisonous plants and weed species. The Crampton collection contains about 35,000 specimens of range plants, featuring grasses and legumes, and includes nine primary type specimens (which are original specimens deposited to document a species when first described). The majority of the collection is from California, providing a priceless documentation of the Central Valley flora. These collections provide reference materials for teaching and are a repository for voucher specimens collected during fieldwork. In the Department of Environmental Horticulture, the Andrew T. Leiser collection consists of 11,000 specimens of ornamental plant species and was developed for teaching purposes.

The Axelrod Paleobotanical Collection contains thousands of select specimens chosen to provide evidence for the vegetation, climate, altitude, and terrain of Tertiary environments. Sites represented include: 1) Eocene and Oligocene subalpine conifer forests from the central cordilleran region (Colorado–New Mexico; Eastern Nevada–Idaho); 2) Eocene-to-Miocene mixed conifer-hardwood forests from Colorado, Nevada, and Idaho; 3) Miocene floras from central and western Nevada that document histories of the Sierra redwood forest and of the broad-leaved sclerophyll vegetation; and early Miocene to middle Pliocene floras from the Sierra Nevada. The fossils are curated by Daniel Axelrod (retired, Botany Department). The collection includes samples from ecosystems not previously known from the fossil record and large collections of genera that enabled studies of evolutionary rate and change in time.

Entomological collections. Collections now housed in the Bohart Museum of Entomology (BME) were started in two wooden boxes in 1947. From this nucleus the collection has grown to six million specimens. It was officially designated as a University Museum in 1987. The BME is one of the major insect collections in North America, with some of the most important collections of certain groups of insects in the world. It is the third largest university-held collection and the ninth largest insect collection nationwide. The collection holdings are worldwide in scope with a strong regional representation; the majority of material is from California and the western United States. In addition, large numbers of specimens have been obtained from special collecting in Australia, South Africa, Zambia, United Arab Emirates, and South and Central America, and from a variety of endangered habitats, particularly in the tropics. The BME also includes 1,498 primary type specimens.

Nematology collection. The University of California Davis Nematode Collection (UCDNC) in the Department of Nematology was originally founded at the University of California, Berkeley in 1944. In 1959 it was transferred to Davis. This collection now contains more than 360,000 specimens. It is the largest of its kind in North America, and is one of the largest in the world. The Nematology collection is the primary repository for type material generated by studies on the systematics of plant parasitic, marine, and free-living nematodes in North America. The UCDNC is also a primary repository of vouchers and type material resulting from studies of biodiversity of animal and plant parasitic nematodes and other helminths. In addition to the extensive collections of nematodes from all major ecosystems of California, special areas of geographic emphasis include parasitic nematodes and other helminths from Bolivia and the Sevilleta Long Term Ecological Research Site (an ecological research area with long-term funding from the National Science Foundation, located in New Mexico). All of the orders and suborders, and at least 90% of the families of the phylum Nemata are represented. The UCDNC is worldwide in scope.



Acquisition of the elements of collections has many facets ranging from simply accepting donations to actively collecting from where the organisms occur in the field. Here Scott Gardner of the Department of Nematology and a field crew seek nematode parasites of wild mammals in Bolivia.

Geology/paleontology collections. The collections in the Department of Geology, under the aegis of the Geology Museum, consist of approximately 3,500 fossils, 4,500 catalogued rocks, and 2,500 minerals from around the world. The collection was started in the 1940s when the Geology Department was developing as a unit independent from the Department of Geology at Berkeley. Dr. Cordell Durrell became department chair in 1963 and built up the older collections into a strong, representative selection of fossils, rocks, and minerals that have been used extensively for teaching purposes. These specimens are easily accessible and form the essential basis to many, if not most, of the courses and laboratory sections taught in the department. The overall importance of the collections lies in their diverse representation of geologic materials. Ancillary materials maintained in the Geology Museum are some 2,000 topographic and geologic maps, accessible for research and teaching.

Vertebrate collections. There are three separate vertebrate collections on the Davis campus: the Museum of Wildlife and Fisheries Biology (MWFB) Collection, a collection in the Zoology Department, and the primate embryo collection at the California Primate Research

Center. The first two collections are primarily used for teaching, but have different emphases. The MWFB collection consists of nearly 8,000 specimens and contains approximately 95% of the species of birds, fish, and mammals of California, about 70% of the North American ones, and a smaller percentage of non-North American species in these groups. This collection serves as a base for teaching materials, and as a repository for voucher material collected during field research. The Zoology collection contains 10,000 specimens and consists primarily of preserved, dry and in liquid, tetrapod vertebrates — amphibians, reptiles, birds, and mammals. Most of these specimens are vouchers from various research projects. The California Primate Research Center embryo collection contains several hundred specimens, used for research and teaching. It has a unique representation of embryonic material from more than seven species of primates. This material is preserved in formalin, on glass slides, and cryogenically. There is no other collection in the United States that rivals this one in scope and completeness.

ISSUES OF MAINTENANCE

The critical maintenance issues for collections are primarily facilities and labor, with the overriding impediment to both being to shortage of funding. Temperature, humidity, and lighting of storage facilities must be controlled. Most collections, living or preserved, face periodic threats from insect, mold, or bacterial pests. In many cases, there is a problem simply to obtain sufficient space for collection storage while allowing access or meeting structural requirements for specialized containers. On the question of limitations, the most frequent response for the living collections was inadequate funding, while inadequate space was most often cited for preserved collections (Table 3 and Appendix 1).

Table 3. Limitations of campus biological collections.

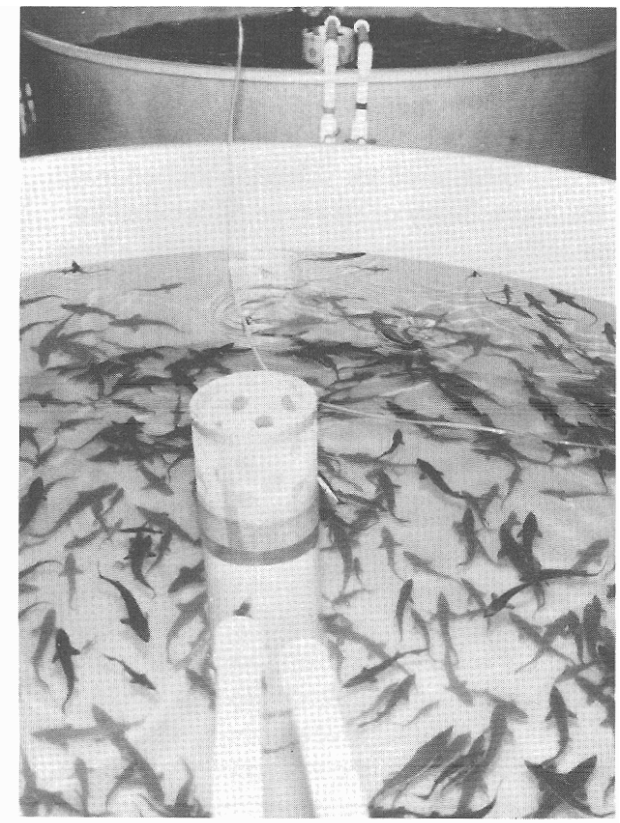
	Living	Preserved	Total
	(Number of collections)		
Inadequate funding	60	4	64
Inadequate space	32	15	47
Inadequate departmental interest	7	0	7
Retirement of personnel	3	1	4
Other	1	1	2
None listed	5	0	5

While the maintenance and distribution of living biological collections require special physical and environmental considerations, there are additional important functions involved. Maintenance and distribution strategies are determined by the biology and genetics of each collection. Of the living collections, those that can only be maintained in the form of active living organisms or colonies (e.g., animals or clonally propagated plants) are most vulnerable to temporary interruptions in support (funding and personnel). On the other hand, many living collections can be stored in

a dormant state for extended periods of time (e.g., plant seeds, bacterial cultures, or animal embryos) yet must be regenerated at regular intervals.

Regeneration strategies (methods and frequency) are influenced by longevity in storage, usage for teaching, research, and distribution, as well as by the genetics and biology of the organism and trait of interest. Ideally, storage conditions should maximize longevity in order to minimize the regeneration frequency. During regeneration, the genetic integrity of an accession is at risk due to the potential for contamination and genetic erosion. Examples of contamination are seed mixing, uncontrolled outcrossing, and disease. Genetic erosion is a loss of the genetic diversity of the original collection due to inadvertent selection during regeneration or changes in gene frequency due to small population sizes and the subsequent effects of random drift or inbreeding depression. Selection can be minimized by growth conditions that result in high survival rates and equal reproductive rates for all individuals. To minimize random drift and inbreeding depression, large effective population sizes should be used for regeneration. Adequate space and facilities are therefore critical for maintaining genetic diversity of collections.

Many of these issues important for regeneration strategies also are relevant to maintenance of collections that must be kept as living colonies or populations. Random drift and inbreeding depression can erode the genetic diversity of insufficiently large animal or plant populations. Behavioral considerations also play an important role in managing animal populations.



Issues of maintenance for collections involve a diverse array of conditions and equipment. Fish collections in the Department of Animal Science require constant movement and filtering of water and controlled water temperatures.

Genetic concerns are more relevant to collections with much inherent genetic variability than to those with little. For plants, outcrossing species tend to be more variable than self-pollinating species; facultative outcrossers must be handled with care since they may self-pollinate in the absence of appropriate vectors or manual cross-pollination. This emphasizes the need for estimation of variability in collections and for familiarity with the mating system of the relevant organism. For animals, most higher organisms are outbreeding, but inbreeding as a result of small population sizes can reduce genetic variability and impair the general health of the population.

Collections containing specific traits of interest may need to be evaluated during regeneration to verify presence of the trait. Depending on the genetic complexity of the trait and the method of verification, evaluation can

represent a major part of the maintenance regime and require very specific expertise.

Distribution of materials in biological collections is an important activity that enables their broadest utilization. Depending on the level of demand, this activity may require considerable effort (e.g., gene banks whose main purpose is distribution). Distribution also provides some insurance against the eventual loss or degradation of an accession in the original collection. The most important collections should be duplicated at another permanent site. For plants, one such site is the National Seed Storage Laboratory. For microbial and fungal collections there are commercial organizations such as the American Type Culture Collection that can serve as a backup service. The situation for animal collections is less organized. With such exceptions as the centers for mouse or fruit fly genetic stocks, there are no national programs, governmental or commercial, that can provide a backup service.

ISSUES OF DOCUMENTATION AND COMMUNICATION

The value of both living and preserved collections depends on accessibility of the collection for teaching, research, and extension. Collection accessibility will depend, in turn, on good documentation of collection contents and communication of those contents to the academic community and general public. The identification and enumeration of collections (Appendix 1) are the initial steps in this process of documentation and organization. However, these summaries do not provide the detailed information on the contents of individual collections that is required for scientific and educational use. At the present time, the accessibility of this type of detailed information varies widely from one collection to the next. It would be advantageous to develop a generic inventory template that, although flexible enough to accommodate different types of collections, would allow the establishment of a common database for collections on campus. This database could be maintained in a hierarchical fashion such that summary statistics or reports on collection contents could be easily abstracted and periodically updated from individual collection inventories. If more detailed information on a particular collection were required, it could be obtained from the individual collection database. Obviously, this system would be most efficient if all the information for all the collections on campus resided in computerized inventories. For certain collections, entering the necessary information onto a computer may entail substantial effort; an interim solution may be to obtain more detailed summaries of collections that could be used in the main database until detailed individual inventories can be computerized. A long-term goal might be to maintain the contents of all collection records in computer databases with similar data structure. This would facilitate updating collections, allow evaluation of the frequency with which collections are used, and also ensure that when a particular curator leaves or retires, the information necessary to use the collection is not lost. Computerized inventories would also improve accessibility; collection databases

could be accessed within the planned campus network system as well as by users worldwide via BITNET or INTERNET electronic mail systems.

THREATS TO COLLECTIONS

The UCD biological collections have both immediate and long-term value, as described above. Similarly, these collections face both immediate and long-term threats. Short-term threats include power failures that jeopardize ultra-cold storage of DNA or circulation pumps for fish tanks, and inadequate staffing leading to loss due to human error or neglect. Long-term threats include departmental reorganizations, after which departmental responsibility for collections may be unclear, retirement of faculty, and changes in research focus of departments as faculty retire and are replaced. Almost one third of the campus living biological collections were described as at risk (Table 4). None of the preserved collections were so described.

Table 4. Status of campus biological collections.

	Living	Preserved	Total
	(Number of collections)		
At risk	36	0	36
Not at risk	49	17	66

Often the burden of maintaining a collection has been directly or indirectly borne by the host department, frequently in the form of allocating support personnel for maintenance or by providing facilities. University budget cuts and overall reductions in industry, State, and Federal funding are forcing a closer look at department resources. Departments are finding they cannot afford the personnel necessary to maintain various collections. Research funds, in many cases, have supported development of collections ancillary to research objectives. However, once established, collections require more money for maintenance and distribution than can be obtained from research funding sources. The major source of support for all collections is the administrative unit for each (Table 5). However, grant support, from federal and state agencies, and donations are also important sources of support for many collections. (Table 5)

Table 5. Sources of support for campus biological collections.

	Living	Preserved	Total
	(Number of collections)		
Grants	44	3	47
University/campus/department	39	14	53
Donations	13	2	15
Fees/sales	3	0	3
None	1	0	1

One of the primary threats is poorly defined responsibility for collections once the supervising faculty member has retired. Twelve collections are managed or curated by retired personnel (Table 2) and three col-

lections are currently limited because of early and normal faculty retirements (Table 3). Newly hired faculty often have research interests very different from those of their predecessors. Furthermore, given the costs associated with maintaining a collection, newly hired faculty are often financially incapable of supporting a collection. The lack of responsibility for collections once the curator or manager has retired must be addressed; if no active voice speaks up, a collection's future is jeopardized

LOSS OF COLLECTIONS

The loss of a collection can mean the physical destruction of the collection or its removal from the campus to another site. The impact of loss of a collection to the campus can be measured not only in terms of the time (and thus FTE effort) and money (salary and supplies) invested in amassing and maintaining it, but also in terms of the time and money that would be necessary to assemble the collection again (if that were possible) or to access materials from holdings at other institutions. In some cases, a loss for the campus means a loss nationally and internationally, depending on the degree of duplication of the collection's contents. There can also be a loss of prestige for the campus when a renowned and widely used collection is allowed to deteriorate or be lost.

Disposal of collections has legal implications for the University, yet disposal decisions have been made without consideration of legal and scientific issues. Communication has been poor, with the disposal by one department of a collection that would have been welcomed by another.

It is instructive to consider the current status of the 11 UC Davis systematics collections that were documented in the 1976 report done by the campus ABC and published in the Association of Systematics Collections Newsletter, referenced in a footnote above. Six have been significantly reduced in space or holdings or transferred away from the Davis campus.

- The John M. Tucker Herbarium: This collection (P4 in Appendix 1) is still located in the Botany Department; inadequate space is the major constraint.
- The Department of Agronomy and Range Science Herbarium: The core holdings are now the Beecher Crampton herbarium collection (P5 in Appendix 1) of the Botany Department's Tucker Herbarium, after bids from the Jepson Herbarium and the California Academy of Sciences when a change of focus in the Agronomy and Range Science Department and the retirement of curator Beecher Crampton rendered the collection's security doubtful.
- The Andrew T. Leiser Herbarium (P6 in Appendix 1): This collection's status within the Department of Environmental Horticulture is unclear due to changes in focus and retirement of curator Andrew Leiser, it may become a component of the Tucker Herbarium.

- The Axelrod Paleobotanical Collection: A major part of the collection (P17 in Appendix 1) is still in the Department of Botany, curated by Professor Emeritus Daniel I. Axelrod, but a number of primary type specimens have been transferred to the UC Berkeley campus.
- The Museum of Wildlife and Fisheries Biology: The collection (P14 in Appendix 1) is still curated by Ron Cole and is growing. Inadequate space is the major constraint.
- The Carnegie Embryological Collection: With the retirement of curator Rohan O'Rahilly, the collection, which had been maintained under the auspices of the California Primate Research Center, has been transferred to the National Museum of Health and Medicine at the Armed Forces Institute of Pathology, Washington, DC.
- The Population Genetics Laboratory: This collection of *Drosophila* maintained for genetic and evolutionary studies was transferred from the campus with the move of its curator, F.J. Ayala, to UC Irvine.
- The Bohart Entomological Collection: The Entomology Department remains strongly in support of the collection (P1 in Appendix 1). It will soon move into new quarters, better equipped for the physical requirements of the collection. Both a new director and a new curator are in place since the 1976 report.
- The University of California Nematode Collection: This is still an active collection (P7 in Appendix 1) in the Nematology Department. The curator recently retired but was replaced in part by a Nematology Department faculty member.
- The Avian Mutant Stocks and Specialty Lines Collection: This is still an active collection (LA1 in Appendix 1) with the same curator, but it faces severe space and financial constraints.
- The International Collection of Phytopathogenic Bacteria: This collection has been lost to the campus by transfer to the UC Berkeley campus. With the retirement of its curator, Mortimer P. Starr, and changes in the Plant Pathology Department's focus, there was no campus interest in maintaining the collection.

UCD'S INVESTMENT IN COLLECTIONS

The campus has made a large investment in assembling and maintaining biological collections over several decades. It is difficult to account directly for this investment in many cases, since support is often derived from research and teaching budgets. Storage and processing facilities are often not designated officially for a collection, but are part of facilities used primarily for research, teaching, or other purposes. The amounts listed for "Current costs" for the collections in the summaries in the Appendix 1 vary in completeness. In almost all cases they are underestimates, since usually only the easily itemized costs such as supplies or salaries of personnel assigned di-

rectly to collections are included. Often missing are estimates of indirect departmental support and costs for time of personnel who contribute to collection maintenance indirectly or on a part-time basis. In a few cases no estimates of annual costs were available. Given these limitations and qualifications, the overall sum of the available annual cost figures from the summaries listed in the Appendix 1 of roughly $1.7 million is an underestimate of the monetary investment in collections by the campus. Not included in this total are the nondepartmental collections with large, established budgets, such as the California Primate Research Center, the Animal Resources Service, the Foundation Plant Materials Service, the Bodega Marine Laboratory, the federal National Germplasm Repository, and the Davis Arboretum.

In a very materialistic sense, the collections comprise a resource for the campus in the same way that the libraries, laboratories, and physical plant are resources. In contrast to how these latter resources are handled, however, the University has not protected its investment in biological resources by any campus-wide attempt at maintenance and inventory.

This picture shows twin Targhee lambs produced by transfer of two frozen embryos to the ewe, demonstrating the viability of embryos frozen up to three years; viability was very good; 55% of transferred embryos resulted in the birth of normal lambs. Preservation of genotypes by embryo freezing is being used to maintain four sheep lines that were subjected to selection for 30 years by researchers in the Department of Animal Science.

APPENDIX 1

Summaries of UCD biological collections

*Each collection in the following summaries has a unique reference number referred to in the following indexes. The prefixes **LA, LM, and LP** indicate, respectively, a living animal collection, pages 25 to 35, a living microbe, alga, fungus, or virus collection or a DNA collection, pages 37 to 47, and a living plant collection, pages 49 to 69. **P** indicates a preserved collection, pages 71 to 79.*

Index by Department/Unit

Index by Department/Unit (cont.)

Index by Department/Unit (cont.)

Index by Curator/Manager

Index by Organism: Family or larger taxonomic category

The following collections contain such a wide range of organisms that they are beyond the scope of a family index.

Animal

Microbe, alga, fungus, virus, DNA

Plant

Miscellaneous

Index by Organism: Family (cont.)

Each of the balance of the collections emphasizes one or a few families and is referenced alphabetically by family within Animal; Microbe, alga, fungus, virus; and Plant categories.

Animal

Microbe, alga, fungus, virus

Plant

Summary of living animal collections

Organism/Collection:	**Domesticated avian species**	**LA1**
Department/Unit:	Avian Sciences	
Usage:	*Research:* Developmental gene regulation, gene transfer studies, nutritional, stress and disease studies; *Teaching:* AVS 100, 102, 202, some Nutrition courses	
Responsible person(s):	Dr. U.K. Abbott	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	1,100 individual birds representing 5 genera	
Coll. growth rate:	Not growing	
Means of storage:	Live animals and frozen semen	
Distribution:	Part of collection internationally distributed on request as funds permit	
Support source:	Departmental and UC GRCP	
Current costs:	$49,500	
Current facilities:	Approx. 5,000 ft² for animal housing, including workspace; additional space and equipment for artificial incubation, feed storage, etc.	
Long-term needs:	New buildings, equipment for egg and embryo freezing	
Status:	Active PI, but threatened due to departmental budget cuts	
Limitation:	Inadequate facilities (for increase and distribution)	

Organism/Collection:	**Domesticated avian species**	**LA2**
Department/Unit:	Avian Sciences	
Usage:	*Research:* Study disease inheritance and resistance; *Teaching:* AVS 100, 102	
Responsible person(s):	Dr. H. Abplanalp (retired)	
Time commitment:	5% of work time	
Unit of collection:	Inbred line and individual genotype	
Size of collection:	1,050 individuals (approx. 50 lines) representing 3 genera	
Coll. growth rate:	Not growing	
Means of storage:	Live animals and refrigerated cDNA libraries	
Distribution:	Internationally distributed as funds permit	
Support source:	Departmental and UC GRCP	
Current costs:	$57,250	
Current facilities:	One brooder house, one building containing cage facilities, and outside cage facilities amounting to about 5,000 ft² including workspace; facilities for artificial incubation, extra service space	
Long-term needs:	Funds for feed and labor	
Status:	Threatened due to departmental budget cuts and retirement of PI	
Limitation:	Inadequate funding (for feed and labor)	

Organism/Collection:	**Mouse genetic stocks**	**LA3**
Department/Unit:	Animal Science	
Usage:	*Research:* Selection for high growth, genetic mapping, growth control and reproduction; *Teaching:* ANS 140, PHS 121	
Responsible person(s):	Dr. G.E. Bradford; Dr. J.D. Murray; Dr. G.B. Anderson; Dr. J.F. Medrano	
Time commitment:	3% of each person's work time	
Unit of collection:	Genotype	
Size of collection:	4,800 embryos	
Coll. growth rate:	300 to 500 embryos/year	
Means of storage:	Embryos under liquid nitrogen	
Distribution:	On request if costs can be covered	
Support source:	UC GRCP & departmental	
Current costs:	$1,500/year for maintenance	
Current facilities:	One liquid nitrogen storage unit, 700 ft² lab space	
Long-term needs:	Backup storage facility and additional funding	
Status:	Active PIs, inadequate funding, slightly threatened	
Limitation:	Inadequate space (backup storage); inadequate funding (liquid nitrogen)	

Organism/Collection:	**Sheep genetic stocks and breeding lines**	**LA4**
Department/Unit:	Animal Science	
Usage:	*Research:* Selection for high growth, genetic mapping, growth control and reproduction; *Teaching:* ANS 123	
Responsible person(s):	Dr. G.E. Bradford; Dr. G.B. Anderson	
Time commitment:	5% of work time; 5% of work time	
Unit of collection:	Genotype	
Size of collection:	109 genotypes	
Coll. growth rate:	Not growing	
Means of storage:	Embryos under liquid nitrogen	
Distribution:	On request if costs can be covered	
Support source:	UC GRCP & departmental	
Current costs:	$1,500/year for maintenance	
Current facilities:	One liquid nitrogen storage unit, 700 ft² lab space	
Long-term needs:	Backup storage facility and additional funding	
Status:	Active PIs, inadequate funding, slightly threatened	
Limitation:	Inadequate space (backup storage); inadequate funding (liquid nitrogen)	

Organism/Collection:	**Research animals–Vertebrates**
Department/Unit:	Animal Resources Service
Usage:	*Research:* Majority of Med. and Vet. Med. departments; *Teaching:* Numerous Vet. Med. classes
Responsible person(s):	Dr. D.L. Brooks
Time commitment:	100% of work time
Unit of collection:	Individual animal
Size of collection:	**Approx.** 26,000 animals
Coll. growth rate:	Not growing
Means of storage:	Live animals
Distribution:	**Primarily UCD** Medical School and Veterinary Medical School departments on a recharge basis
Support source:	University funds, federal grant funds, contracts with private companies
Current costs:	Staff: 3 FTE vets, 5 FTE administrators, 42 technicians and caretakers; Animal purchases; Facilities
Current facilities:	200,000 ft² indoor housing; 300,000 ft² outdoor pens and corrals; 93 ac pasture; 2,500 ft² office space
Long-term needs:	No additional facilities or funding needs anticipated
Status:	Active director, integral relationship to research and teaching recognized by funding structure
Limitation:	Increasing competition for land; increasing cost of animal welfare standards

Organism/Collection:	**Domestic horse, cattle, and llama serum and DNA** **LA6**
Department/Unit:	Vet Med/Reproduction
Usage:	*Service:* Testing of individuals for parentage; testing overall herd health; testing for disease antibodies
Responsible person(s):	Dr. A. Bowling
Time commitment:	5% of work time
Unit of collection:	Individual serum sample; DNA sample
Size of collection:	150,000 serum samples; 200 DNA samples
Coll. growth rate:	Not growing; new samples replace old samples
Means of storage:	Frozen serum samples; frozen or refrigerated DNA samples
Distribution:	None
Support source:	Horse owners charged for serum testing
Current costs:	$25,000/year
Current facilities:	500 ft³ freezer space; 2,500 ft² lab space
Long-term needs:	Additional freezers and space for freezers
Status:	Samples discarded after 3 years; unable to store serum or DNA long term due to lack of frozen storage space
Limitation:	Inadequate space (for freezers)

Organism/Collection:	***Drosophila melanogaster* genetic stocks**	**LA7**
Department/Unit:	Genetics	
Usage:	*Research:* Genetic model of DNA repair mechanisms	
Responsible person(s):	Dr. J.B. Boyd	
Time commitment:	5% of work time	
Unit of collection:	Genetic stock	
Size of collection:	800 stocks	
Coll. growth rate:	24 stocks/year	
Means of storage:	Live animal populations	
Distribution:	Distribution worldwide, approx. 25 shipments/year	
Support source:	Federal grant	
Current costs:	$7,000/year labor, $4,000/year materials	
Current facilities:	300 ft² lab space	
Long-term needs:	New incubation facility	
Status:	Active PI but funds may be lost in 1 to 2 years	
Limitation:	Inadequate funding (labor for transfers); inadequate facility (for incubation)	

Organism/Collection:	**White sturgeon: wild and selected lines**	**LA8**
Department/Unit:	Animal Science	
Usage:	*Research:* Endocrinology, development, spawning, nutrition, growth hormones, genome study; *Teaching:* ANS 118, 131; *Service:* Work with California fish farmers	
Responsible person(s):	Dr. S. Doroshov	
Time commitment:	5% of work time	
Unit of collection:	Individual organism	
Size of collection:	336 individuals	
Coll. growth rate:	None	
Means of storage:	Live animals	
Distribution:	International distribution upon request	
Support source:	Departmental and federal funds	
Current costs:	$30,000/year	
Current facilities:	1 ac of fiberglass tanks, 2,500 ft² lab space	
Long-term needs:	Water circulation system needs urgent repair	
Status:	Active PI, endangered due to loss of departmental funds in 1992	
Limitation:	Inadequate funding	

Organism/Collection:	**Grape *Phylloxera***	**LA9**
Department/Unit:	Entomology	
Usage:	*Research:* Pest control options, development of pesticides and resistant root stocks in grape Identification of biotypes for farmers; *Teaching:* ENT 100, 115; *Service:* Cooperative Extension classes	
Responsible person(s):	Dr. J. Granett; J. DeBenedictis (staff)	
Time commitment:	5% of work time	
Unit of collection:	Colony of biotypes	
Size of collection:	39 colonies, seasonal	
Coll. growth rate:	If funded in future, 75 colonies/year (currently, colonies are discarded as soon as typed)	
Means of storage:	Live animal colonies	
Distribution:	None	
Support source:	American Vinegar Foundation	
Current costs:	$500/year salary of PT student	
Current facilities:	20 ft^3 incubator storage 50 ft^2 work space	
Long-term needs:	Double the lab space	
Status:	Active PI, not currently in danger	
Limitation:	Inadequate funding (labor for colony maintenance)	

Organism/Collection:	***Drosophila* genetic stocks**	**LA10**
Department/Unit:	Genetics	
Usage:	*Research:* Gene cloning, developmental genetics model; *Teaching:* GEN 102	
Responsible person(s):	Dr. M.M. Green (retired)	
Time commitment:	100% of work time	
Unit of collection:	Genotype	
Size of collection:	335 genotypes	
Coll. growth rate:	25 to 30 genotypes/year	
Means of storage:	Live animals	
Distribution:	Internationally upon request	
Support source:	UC GRCP	
Current costs:	$1,000/year materials, $3,000/year labor	
Current facilities:	1,000 ft^2 laboratory storage and work space	
Long-term needs:	Facilities for cryopreservation of collection	
Status:	No active PI, lack of departmental interest and financial support	
Limitation:	Inadequate funding (labor)	

Organism/Collection:	**Oyster species**	**LA11**
Department/Unit:	Animal Science–Bodega Marine Laboratory	
Usage:	*Research:* Genetic analysis of production traits; genetic markers; conservation of rare species	
Responsible person(s):	Dr. D. Hedgecock	
Time commitment:	5% of work time	
Unit of collection:	Family	
Size of collection:	150 families + 7 inbred lines + 75 brood stock individuals; 5 species	
Coll. growth rate:	New collection, growth will decrease in the future	
Means of storage:	Live animals	
Distribution:	Internationally distributed as funds permit	
Support source:	Federal – USDA, WRAC	
Current costs:	$2,000/year materials and water, salaries unknown	
Current facilities:	2,000 ft² greenhouse, 400 ft² hatchery room, 600 ft² field space in bay, 200 ft² laboratory for algae production	
Long-term needs:	No additional needs	
Status:	Active PI, not currently in danger	
Limitation:	Inadequate funding (labor)	

Organism/Collection:	**Non-human primates**	**LA12**
Department/Unit:	California Primate Research Center	
Usage:	*Research:* Ten campus departments, more than 50 faculty and graduate students; *Teaching:* VM 413, 470	
Responsible person(s):	Dr. A.G. Hendrickx	
Time commitment:	100% of work time	
Unit of collection:	Individual animal	
Size of collection:	3,200 to 3,400 animals	
Coll. growth rate:	Not growing	
Means of storage:	Live animals in pens and cages	
Distribution:	To campus departments and other universities and US primate centers on a fee basis	
Support source:	Federal grants (NIH), UC departments, private research contracts	
Current costs:	$2.8 million	
Current facilities:	300 ac, including 0.5 ac pens, 340,000 ft² cage facilities, labs	
Long-term needs:	Renovation of existing space	
Status:	Active unit, adequate funding, not currently in danger	
Limitation:	Increasing costs of meeting animal welfare standards	

Organism/Collection:	**Insect-parasitic nematodes**	**LA13**
Department/Unit:	Nematology	
Usage:	*Research:* Insect pathogens, biocontrol; *Teaching:* NEM 240	
Responsible person(s):	Dr. H. Kaya; Dr. S.L. Gardner	
Time commitment:	8% and 2% of work time, respectively	
Unit of collection:	Sample from insect hosts	
Size of collection:	30 species and strains	
Coll. growth rate:	4 to 5 species/year	
Means of storage:	Refrigeration	
Distribution:	Internationally distributed upon request	
Support source:	Departmental, industry grants	
Current costs:	$10,000/year	
Current facilities:	20 ft² refrigerator	
Long-term needs:	0.25 FTE for maintenance, liquid nitrogen for long-term storage of viable cultures	
Status:	Active PIs, not currently in danger	
Limitation:	Constant culturing requirements; constant monitoring of liquid nitrogen tanks	

Organism/Collection:	**Chicken genetic stocks**	**LA14**
Department/Unit:	Avian Sciences	
Usage:	*Research:* Study of endocrine regulation of monochime enzyme release	
Responsible person(s):	Dr. K. Klasing	
Time commitment:	5% of work time	
Unit of collection:	Inbred line	
Size of collection:	1 inbred line	
Coll. growth rate:	New collection, 1 to 10 specimens/year anticipated	
Means of storage:	Live animals	
Distribution:	Not currently distributed	
Support source:	Departmental	
Current costs:	$2,250	
Current facilities:	Approx. 200 ft² of general housing; artificial incubation facility; extra service space	
Long-term needs:	Better quality animal housing	
Status:	Active PI, not currently in danger	
Limitation:	None listed	

Organism/Collection:	**Parrots**	**LA15**
Department/Unit:	Avian Sciences	
Usage:	***Research:*** **Reproductive** physiology and nutrition; *Teaching:* AVS 100, 123	
Responsible person(s):	Dr. J. Millam	
Time commitment:	**20% of work** time	
Unit of collection:	Species	
Size of collection:	**Approx.** 65 orange-winged Amazons; 350 cockatiels	
Coll. growth rate:	Not growing	
Means of storage:	**Live animals**	
Distribution:	**Amazons are** not yet distributed; cockatiel as numbers permit	
Support source:	**State, grants**, and donations	
Current costs:	**$28,500**	
Current facilities:	**Approx. 4,000** ft² animal quarters including workspace	
Long-term needs:	**Better quality** animal housing; increased funding for feed and labor	
Status:	**Active PI, t**hreatened because of departmental budget cuts	
Limitation:	**Inadequate** facilities, inadequate funding (labor)	

Organism/Collection:	**Honey bee stocks**	**LA16**
Department/Unit:	Entomology	
Usage:	***Research:*** Genetics of pollen hoarding trait, mapping of behavioral, sex and MDH loci, ID of European vs. African bees; *Service:* Work with California bee keepers	
Responsible person(s):	Dr. R. Page	
Time commitment:	**5% of work** time	
Unit of collection:	Hive	
Size of collection:	**50 to** 60 hives	
Coll. growth rate:	10 hives/year	
Means of storage:	Live animals	
Distribution:	**Internationally** distributed as funds permit	
Support source:	NSF and California Dept. of Food and Agriculture grants	
Current costs:	$20,000/year labor and materials	
Current facilities:	15 apiaries, each requires 200 ft²	
Long-term needs:	New hives	
Status:	Active PI but funding terminates in 1992, so collection will be abandoned unless new funding found	
Limitation:	Inadequate funding (hives)	

Organism/Collection:	**Honey bee stocks**	**LA17**
Department/Unit:	Entomology	
Usage:	*Research:* Cryopreservation studies, studies of sperm and egg interactions; *Teaching:* ENT 101, 119, 219	
Responsible person(s):	Dr. C. Peng	
Time commitment:	5% of work time	
Unit of collection:	Hive	
Size of collection:	41 hives representing 10 colonies of mutant stocks	
Coll. growth rate:	Not growing (actually shrinking)	
Means of storage:	Live and cryopreserved whole animals	
Distribution:	Nationally distributed upon request	
Support source:	UC GRCP and other University funds	
Current costs:	$10,000/year	
Current facilities:	5 apiaries, each 6,000 ft^2	
Long-term needs:	Artificial insemination laboratory, additional hives, bee germplasm conservation center and cryopreservation specialist	
Status:	Active PI but unable to fund artificial insemination to continue hives	
Limitation:	Inadequate funding (labor), inadequate facilities	

Organism/Collection:	***Drosophila pseudoobscura* and *D. melanogaster***	**LA18**
Department/Unit:	Genetics	
Usage:	*Research:* Cytogenetics to study chromosome rearrangements, population genetics to study male fitness	
Responsible person(s):	Dr. T. Prout (retired)	
Time commitment:	100% of work time	
Unit of collection:	Genotype	
Size of collection:	8 stocks	
Coll. growth rate:	2 specimens/year	
Means of storage:	Live animals	
Distribution:	Nationally distributed as funds permit	
Support source:	Private funds and UC GRCP	
Current costs:	$300/year materials	
Current facilities:	15 ft^3 temperature controlled storage, common kitchen for food preparation	
Long-term needs:	None listed	
Status:	No active PI, no departmental interest or funding, all work and supplies contributed by Dr. Prout	
Limitation:	Inadequate departmental interest	

Organism/Collection:	**Amphibians and reptiles**
Department/Unit:	Zoology
Usage:	*Research:* Molecular systematics and phylogeny, genetics of metamorphosis and locomotor performance; *Teaching:* ZOO 134, BIS 1B
Responsible person(s):	Dr. B. Shaffer
Time commitment:	5% of work time
Unit of collection:	Genotype
Size of collection:	7,000 genotypes of Ambystomatidae and 15 other families
Coll. growth rate:	2,000 to 3,000 genotypes/year
Means of storage:	Live animals, frozen tissue, genomic and cDNA
Distribution:	No distribution
Support source:	Federal and State funding
Current costs:	$10,000/year for maintenance of live animals, $3,000/year for maintenance of frozen tissues
Current facilities:	300 ft² cooler space, 40 ft³ ultra-cold freezer space, 1,200 ft² common DNA laboratory space
Long-term needs:	Additional cooler storage and funds for labor
Status:	Active PI, inadequate funding so live animals may be lost from collection
Limitation:	Inadequate funding (labor for live animal care)

Organism/Collection:	**Collection of parasitic filarial worms and mosquito vectors** **LA20**
Department/Unit:	Entomology
Usage:	*Research:* Microbial control of mosquitoes, insecticide susceptibility tests, vector competence; *Service:* Teaching programs for public
Responsible person(s):	Dr. R. Washino
Time commitment:	5% of work time
Unit of collection:	Not listed
Size of collection:	Not listed
Coll. growth rate:	2 mosquito species/year
Means of storage:	Live animals (parasite kept in host)
Distribution:	Nationally distributed upon request
Support source:	University, Federal, and private funding
Current costs:	Not listed
Current facilities:	100 ft² insectory for mosquito, 100 ft² for host animal pens, 1,800 ft² laboratory space
Long-term needs:	Better control of environment in insectory, additional holding facilities for host animals
Status:	Active PI, threatened, inadequate funding
Limitation:	Inadequate facilities, inadequate funding (labor)

Organism/Collection:	**Dystrophic chickens**	**LA21**
Department/Unit:	Avian Sciences	
Usage:	*Research:* Used as a model for study of muscular dystrophy	
Responsible person(s):	Dr. B. Wilson	
Time commitment:	5% of work time	
Unit of collection:	Mutant line	
Size of collection:	Approx. 165	
Coll. growth rate:	Not growing	
Means of storage:	Live animals	
Distribution:	Distributed on a fee basis for research	
Support source:	Grants, fees	
Current costs:	$7,450	
Current facilities:	Approx. 700 ft^2 general housing, including workspace, plus use of artificial incubation facility	
Long-term needs:	Better quality animal housing	
Status:	Threatened because of discontinued support from Muscular Dystrophy Association	
Limitation:	Inadequate funding	

Summary of living microbe, alga, fungus, virus, or DNA collections

Organism/Collection:	**Yeast genetic stocks and wild species**	**LM1**
Department/Unit:	Viticulture and Enology	
Usage:	*Research:* Factors affecting wine production, DNA composition of wine yeasts, molecular genetics and physiology of glucose transport in *Saccharomyces cerevisiae*; *Teaching:* VEN 124, MIC 250; *Service:* Work with California wine industry	
Responsible person(s):	Dr. L.F. Bisson	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	200 genotypes	
Coll. growth rate:	5 to 10 genotypes/year	
Means of storage:	Live cell populations and cryogenically frozen cells	
Distribution:	Upon request to other universities	
Support source:	Private grant	
Current costs:	**$2,000/year** for labor and $500/year for supplies	
Current facilities:	400 ft² lab space, cryogenic freezer, incubator, refrigerator, and freeze dryer	
Long-term needs:	Additional 400 ft² lab space, eventual replacements for current facilities:	
Status:	Active PI, not currently in danger	
Limitation:	Inadequate funding (up to $10,000/year)	

Organism/Collection:	***Tritrichomonas foetus* strains**	**LM2**
Department/Unit:	Vet Med/Reproduction	
Usage:	*Research:* Study of pathogenesis of disease organism; *Teaching:* VMD 445C; *Service:* Work with Cattlemen's Association	
Responsible person(s):	Dr. R. BonDurant	
Time commitment:	5% of work time	
Unit of collection:	Genotype (strain)	
Size of collection:	37 genotypes	
Coll. growth rate:	30 to 40 strains/year	
Means of storage:	Live cell populations	
Distribution:	On request to government and university laboratories	
Support source:	USDA and private grants	
Current costs:	$2,400/year for liquid nitrogen, $50/year for supplies, 10% of FTE for labor	
Current facilities:	200L liquid nitrogen tank, 250 ft² lab, flow hood, incubators, inverted microscopy	
Long-term needs:	Storage space for equipment	
Status:	Active PI but threatened due to prohibitive cost of liquid nitrogen	
Limitation:	Inadequate space (storage and laboratory)	

Organism/Collection:	**Plant viruses**	**LM3**
Department/Unit:	Plant Pathology	
Usage:	*Research:* Mechanisms of resistance to viruses; *Teaching:* PLP 226	
Responsible person(s):	Dr. G. Bruening	
Time commitment:	5% of work time	
Unit of collection:	Virus serotype	
Size of collection:	Five viruses	
Coll. growth rate:	Static	
Means of storage:	Glycerol at low temperature in freezer	
Distribution:	Distributed on request to qualified researchers	
Support source:	Federal grant support	
Current costs:	$1,000/year	
Current facilities:	2 -20°C freezers (=40 ft^3), 500 ft^2 lab ; space, filing cabinet	
Long-term needs:	Nothing more except lab space	
Status:	Active PI, not currently at risk	
Limitation:	Inadequate space (laboratory)	

Organism/Collection:	**Plant pathogenic bacteria**	**LM4**
Department/Unit:	Plant Pathology	
Usage:	*Research:* Bacterial plant diseases	
Responsible person(s):	Dr. R.N. Campbell	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	300 genotypes	
Coll. growth rate:	5 genotypes/year	
Means of storage:	Live cell populations and dried on silica gel	
Distribution:	Internationally upon request, ATCC	
Support source:	Departmental	
Current costs:	$500/year labor, $100/year materials	
Current facilities:	50 ft^3 freezer storage, 250 ft^2 lab space (shared with fungus collection)	
Long-term needs:	More freezer space	
Status:	Current active PI, but will retire in 3 to 5 years	
Limitation:	Inadequate funding (labor), retirement of investigator	

Organism/Collection:	**Plant pathogenic fungi and plant viruses**	**LM5**
Department/Unit:	Plant Pathology	
Usage:	*Research:* Fungal transmission of plant viruses; *Teaching:* PLP 120	
Responsible person(s):	Dr. R.N. Campbell	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	60 virus isolates; 50 fungus genotypes	
Coll. growth rate:	5 specimens/year	
Means of storage:	Fungi: live plant populations; Viruses: dried	
Distribution:	Internationally upon request; ATCC	
Support source:	Departmental	
Current costs:	$500/year labor, $100/year materials	
Current facilities:	Fungus: 50 ft^3 refrigerated storage, 250 ft^2 lab space (shared with bacteria collection)	
Long-term needs:	More temperature controlled storage	
Status:	Current active PI, but will retire in 3 to 5 years	
Limitation:	Inadequate funding (labor)	

Organism/Collection:	**Bacteria and fungi teaching collection**	**LM6**
Department/Unit:	Plant Pathology	
Usage:	***Teaching:*** **PLP** 120; *Service:* Plant diagnosis for farmers	
Responsible person(s):	Dr. B. Falk	
Time commitment:	**5% of work** time	
Unit of collection:	Genotype	
Size of collection:	**25 fungi**, bacteria, viruses	
Coll. growth rate:	Not growing	
Means of storage:	**Live plant** and cell populations, some freeze dried	
Distribution:	None	
Support source:	Federal and state	
Current costs:	**$4,000/year labor** and materials	
Current facilities:	5 ft^3 incubator	
Long-term needs:	None	
Status:	**No funds for** maintenance, endangered	
Limitation:	Inadequate funding (for maintenance)	

Organism/Collection:	**Plant viruses**	**LM7**
Department/Unit:	Plant Pathology	
Usage:	*Research:* Virus epidemic control, symptom development; *Teaching:* PLP 120, 226	
Responsible person(s):	Dr. B. Falk	
Time commitment:	5% of work time	
Unit of collection:	Virus serotype	
Size of collection:	100 serotypes	
Coll. growth rate:	25 serotypes/year	
Means of storage:	Freeze-dried conditions	
Distribution:	US institutions upon request	
Support source:	Federal and state funds	
Current costs:	$1,000/year (does not include cost of drying)	
Current facilities:	10 ft^3 freezer at -20°C degrees	
Long-term needs:	Additional freezer space	
Status:	Active PI, adequate funding, not currently in danger	
Limitation:	Inadequate funding (for labor to organize collection)	

Organism/Collection:	**Viruses of grape vines**	**LM8**
Department/Unit:	Plant Pathology/USDA-ARS	
Usage:	*Research:* Virus characterization and identification; *Teaching:* VEN 111, 118, PLP 120, PPP 202A; *Service:* Cooperative Extension classes	
Responsible person(s):	Dr. D. Golino	
Time commitment:	5% of work time	
Unit of collection:	Virus isolate	
Size of collection:	550 isolates	
Coll. growth rate:	Variable	
Means of storage:	Live viruses on host organism	
Distribution:	Internationally by request	
Support source:	Federal and industry grants	
Current costs:	$10,000/year, includes set-up costs for new collection	
Current facilities:	2,000 ft^2 greenhouse, 3 ac field space, 150 ft^2 laboratory storage and research space, 10 ft^3 low temperature storage	
Long-term needs:	Quarantine and containment facilities	
Status:	Active PI but funding cut and collection in danger of being abandoned	
Limitation:	Inadequate funding	

Organism/Collection:	**Nematophagous fungi**	LM9
Department/Unit:	Nematology	
Usage:	*Research:* Biological control of pest nematodes and study of the ecology of fungi in the soil; *Teaching:* NEM 100, 222, 240, SSC 100; *Service:* Work with California growers	
Responsible person(s):	Dr. B. Jaffee	
Time commitment:	5% of work time	
Unit of collection:	Isolate	
Size of collection:	100 isolates representing 20 to 30 genera	
Coll. growth rate:	10 isolates/year	
Means of storage:	Live plant under refrigerated conditions	
Distribution:	Internationally distributed upon request	
Support source:	Departmental	
Current costs:	$3,600/year labor, $500/year materials	
Current facilities:	20 ft^3 refrigerated storage, 20 ft^3 unrefrigerated storage, 500 ft^2 laboratory space	
Long-term needs:	More laboratory space and quarantine facilities	
Status:	Active PI, not currently in danger	
Limitation:	Inadequate facilities (storage and laboratory), inadequate funding (labor)	

Organism/Collection:	**Bacteria**	**LM10**
Department/Unit:	Plant Pathology–Davis crown gall group	
Usage:	*Research:* Primary usage; *Teaching:* PLP 120, 228 and at other universities	
Responsible person(s):	Dr. C. Kado	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	4,000+ genotypes	
Coll. growth rate:	20 genotypes/year	
Means of storage:	Live bacteria stored lyophilized and cryopreserved	
Distribution:	National universities upon request	
Support source:	Departmental, other University, and private funds	
Current costs:	$12,000/year	
Current facilities:	Laboratory space	
Long-term needs:	Temperature controlled storage space	
Status:	Active PI, in need of funding for labor	
Limitation:	Inadequate funding (labor), inadequate space	

Organism/Collection:	**Gene banks and libraries**	**LM11**
Department/Unit:	Plant Pathology–Davis crown gall group	
Usage:	*Research*	
Responsible person(s):	Dr. C. Kado	
Time commitment:	5% of work time	
Unit of collection:	DNA sequence	
Size of collection:	500+	
Coll. growth rate:	20 sequences/year	
Means of storage:	DNA stored under frozen conditions	
Distribution:	Nationally distributed as funds permit	
Support source:	Departmental, other University, and Federal funds	
Current costs:	$500/year materials	
Current facilities:	Laboratory space and freezer storage	
Long-term needs:	Need an ultracold freezer and personnel for maintenance	
Status:	Active PI, threatened–no funds for adequate maintenance	
Limitation:	Inadequate funding (labor), inadequate space (freezer storage)	

Organism/Collection:	**Plasmid vectors**	**LM12**
Department/Unit:	Plant Pathology–Davis crown gall group	
Usage:	*Research*; *Teaching*	
Responsible person(s):	Dr. C. Kado	
Time commitment:	5% of work time	
Unit of collection:	Genotype of inserted DNA	
Size of collection:	500+ plasmids	
Coll. growth rate:	20 genotype-plasmids/year	
Means of storage:	DNA stored under frozen conditions	
Distribution:	Nationally distributed as funds permit	
Support source:	Departmental, other University, and Federal funds	
Current costs:	$500/year materials	
Current facilities:	Laboratory and freezer storage space	
Long-term needs:	Need an ultrafreezer and personnel for maintenance	
Status:	Active PI, threatened–no funds for adequate maintenance	
Limitation:	Inadequate funding (labor), inadequate space (freezer storage)	

Organism/Collection:	**Spirochete collection**	**LM13**
Department/Unit:	Entomology	
Usage:	*Research*; *Teaching:* ENT 100, 110, 156	
Responsible person(s):	Dr. B. Kimsey	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	127 genotypes	
Coll. growth rate:	100 genotypes/year	
Means of storage:	Whole organism maintained under refrigerated conditions	
Distribution:	Nationally distributed upon request	
Support source:	Privately funded	
Current costs:	< $100/year after purchase of low temperature freezer	
Current facilities:	3 ft^3 freezer space	
Long-term needs:	One -80°C freezer	
Status:	Active PI, adequate funding, collection not currently in danger	
Limitation:	Inadequate space (collection-specific freezer storage)	

Organism/Collection:	**Deletion mutants of yeast**	**LM14**
Department/Unit:	Microbiology	
Usage:	*Research:* Protein sorting studies	
Responsible person(s):	Dr. D. Klionski	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	10 genotypes	
Coll. growth rate:	1 genotype/year	
Means of storage:	Frozen in glycerol at -80°C	
Distribution:	Distributed upon request with approval of originator	
Support source:	Grant funds	
Current costs:	$500 materials	
Current facilities:	2 -80°C freezers	
Long-term needs:	More -80°C storage space	
Status:	Active PI, not currently in danger	
Limitation:	Inadequate space	

Organism/Collection:	**Wine yeast and bacteria**	**LM15**
Department/Unit:	Viticulture and Enology	
Usage:	*Research:* Isolation and characterization of wine spoilage organisms and their enzymes and DNA characterization; *Teaching:* VEN 124, 217; *Service:* University Extension classes, work with wine industry	
Responsible person(s):	Dr. R. Kunkee (retired); Dr. L.F. Bisson; M. Vilas (staff)	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	500 genotypes	
Coll. growth rate:	20 genotypes/year	
Means of storage:	Whole microbe on agar slants under oil, being lyophilized for cryogenic preservation	
Distribution:	Internationally distributed upon request	
Support source:	Departmental	
Current costs:	$2,000 labor, $500 materials	
Current facilities:	400 ft² laboratory space, 50 ft³ temperature controlled storage space	
Long-term needs:	Additional space and funding for labor	
Status:	Retired PI, inadequate funding, but not currently in danger	
Limitation:	Inadequate funding (maintenance)	

Organism/Collection:	**Algae collection**	**LM16**
Department/Unit:	Botany	
Usage:	*Research:* Ultrastructure of selected marine algae; *Teaching:* BIS 1C, BOT 118; *Service:* Davis Science Center exhibit	
Responsible person(s):	Dr. N.J. Lang (retired)	
Time commitment:	15% of work time	
Unit of collection:	Species	
Size of collection:	200 species	
Coll. growth rate:	Not growing	
Means of storage:	**Live plants** on agar slants	
Distribution:	Not distributed, is primarily a teaching collection	
Support source:	Departmental	
Current costs:	$200/year materials, 5 hours/wk labor	
Current facilities:	20 ft² temperature controlled storage, 75 ft² lighted shelf space, 15 ft² transfer room	
Long-term needs:	None listed	
Status:	No active PI, no funds, no departmental interest; much of collection has already been lost and remaining collection is highly imperiled	
Limitation:	Inadequate departmental interest, no active investigator	

Organism/Collection:	**Fungi teaching collection**	**LM17**
Department/Unit:	Botany	
Usage:	*Teaching:* BIS 1C, BOT 10, 119	
Responsible person(s):	S. Larson (staff)	
Time commitment:	5% of work time	
Unit of collection:	Species	
Size of collection:	106 species	
Coll. growth rate:	Not growing	
Means of storage:	Whole organism cultures on agar slants	
Distribution:	Not distributed	
Support source:	Departmental	
Current costs:	$750/year supplies, $8,500/year for 0.25 FTE	
Current facilities:	8 ft^3 growth chamber	
Long-term needs:	Faculty to continue teaching BOT 119	
Status:	No active PI, not currently in danger	
Limitation:	Danger of contamination	

Organism/Collection:	***Bremia lactucae***	**LM18**
Department/Unit:	Vegetable Crops	
Usage:	*Research:* Detection of resistance genes in lettuce, classical and molecular genetic studies on fungal variation and virulence	
Responsible person(s):	Dr. R. Michelmore	
Time commitment:	1% of work time	
Unit of collection:	Isolate	
Size of collection:	Approx. 300 isolates from around the world, but mainly from California	
Coll. growth rate:	5%/year	
Means of storage:	Asexual spores at -80°C	
Distribution:	Internationally upon request; most frequently requests are from Calif. seed companies (only Calif. isolates)	
Support source:	Sporadic funding, leveraged from other funds; occasional donation	
Current costs:	$10,000/year, materials plus equipment	
Current facilities:	830 ft^2 laboratory, containment facilities for exotic isolates; controlled temperature and light growth room	
Long-term needs:	Better documentation of existing isolates, more extensive collection from several areas, exchange with other collections in England, France, and Holland to ensure duplication	
Status:	Active PI, funding sporadic, storage space constraints	
Limitation:	Inadequate funding (labor), inadequate space (freezer space, separate backup)	

Organism/Collection:	**Pathogenic fungi**	**LM19**
Department/Unit:	Med/Microbiology and Immunology	
Usage:	*Research:* Study of cDNA to produce antigens for diagnosis & immunizations, study of structure & development of cocci cells, study of pathogenesis & possible cures; *Teaching:* MMI 480B, VMI 127; *Service:* Diagnoses for local veterinarians & hospitals	
Responsible person(s):	Dr. D. Pappagianis	
Time commitment:	5% of work time	
Unit of collection:	Colony	
Size of collection:	30 colonies	
Coll. growth rate:	2 to 5 specimens/year	
Means of storage:	Live plants (colonies on agar slants)	
Distribution:	Nationally distributed upon request	
Support source:	Departmental and private funds	
Current costs:	$500/year materials (very little labor required)	
Current facilities:	48 ft^3 temperature controlled storage	
Long-term needs:	None listed	
Status:	Active PI, threatened, funding to terminate in future	
Limitation:	Inadequate funding	

Organism/Collection:	**Yeast culture collection**	**LM20**
Department/Unit:	Food Science and Technology	
Usage:	*Research:* Taxonomy and characterization of yeasts; *Teaching:* FST 104L	
Responsible person(s):	Dr. H. Phaff (retired)	
Time commitment:	100% of work time	
Unit of collection:	Strain (genotype)	
Size of collection:	2,000 strains representing 3 families	
Coll. growth rate:	150 strains/year	
Means of storage:	Live populations under refrigerated conditions	
Distribution:	Internationally distributed as funds permit	
Support source:	UC GRCP	
Current costs:	$2,000/year for supplies and labor	
Current facilities:	250 ft^2 refrigerated storage space; 750 ft^2 laboratory space	
Long-term needs:	Collection needs a curator as Dr. Phaff is retired	
Status:	No active PI, no departmental funding, no curator; collection is endangered	
Limitation:	Inadequate funding (for curator), inadequate departmental interest	

Organism/Collection:	**Yeast genetic stocks**	**LM21**
Department/Unit:	Food Science and Technology	
Usage:	*Research:* Studies of yeast cell cycles and meiosis; *Teaching:* FST 104L	
Responsible person(s):	Dr. E. Shuster	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	500 genotypes	
Coll. growth rate:	100 genotypes/year	
Means of storage:	Live microbes stored in glycerol at -80°C, plasmids with genomic DNA	
Distribution:	Nationally distributed upon request	
Support source:	Departmental and Federal	
Current costs:	$500 to 1,000/year	
Current facilities:	13 ft^3 freezer space, temperature controlled incubators	
Long-term needs:	Additional low temperature freezers	
Status:	Active PI, adequate funding, collection not currently in danger	
Limitation:	New collection, must get all data onto computer	

Organism/Collection:	**Plant viruses and mycoplasma**	**LM22**
Department/Unit:	Plant Pathology/USDA-ARS	
Usage:	*Research:* Characterization and control of viruses; *Teaching:* Plant Pathology courses, other integrated pest management classes; *Service:* Demonstrations for growers and nursery personnel	
Responsible person(s):	Dr. J. Uyemoto	
Time commitment:	5% of work time	
Unit of collection:	Strain	
Size of collection:	4 viruses (many strains of some), 2 mycoplasma strains, and 1 rickettsia	
Coll. growth rate:	Very slow	
Means of storage:	In live hosts	
Distribution:	Nationally distributed upon request	
Support source:	Private and state funding	
Current costs:	$750 to 1,000/year labor	
Current facilities:	2.5 ac field space, 150 ft^2 laboratory space	
Long-term needs:	Additional field space	
Status:	Active PI, possible loss of funding may threaten collection	
Limitation:	Inadequate funding	

Summary of living plant collections

Organism/Collection:	**Foundation plant materials collection of grapes, fruit and nut trees, roses, and strawberries**	**LP1**
Department/Unit:	Foundation Plant Materials Service	
Usage:	*Service:* Increase of vegetatively propagated materials for commercial growers	
Responsible person(s):	Dr. R. Ball (retired); S. Nelson-Kluk (staff)	
Time commitment:	100% of work time	
Unit of collection:	Clone	
Size of collection:	4,967 clones	
Coll. growth rate:	300 clones/year	
Means of storage:	Live plants	
Distribution:	Materials for sale to growers and other institutions	
Support source:	Private donation and funds from sale of materials	
Current costs:	Not listed	
Current facilities:	2,400 ft² greenhouse space, 1,800 ft² screenhouse space, 60 ac field space	
Long-term needs:	None listed	
Status:	Active PI, not currently in danger	
Limitation:	None listed	

Organism/Collection:	***Actinidia* breeding lines**	**LP2**
Department/Unit:	Pomology	
Usage:	*Research:* Improvement of crop through breeding and cultural techniques; *Teaching:* POM 102, 210	
Responsible person(s):	Dr. F.A. Bliss	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	279 individuals representing 7 species	
Coll. growth rate:	5 to 10 genotypes/year	
Means of storage:	Live plants	
Distribution:	To private breeder, upon request	
Support source:	University and private grant funds	
Current costs:	$6,000/year labor and supplies	
Current facilities:	200 ft² screen house and 1 ac field plot	
Long-term needs:	Wire trellises to support each plant	
Status:	Active PI, not currently in danger	
Limitation:	Inadequate funding (for trellises and maintenance)	

Organism/Collection:	**Wild and domesticated lines of strawberries**	**LP3**
Department/Unit:	Pomology	
Usage:	*Research:* Cultivar release	
Responsible person(s):	Dr. R. Bringhurst (retired)	
Time commitment:	100% of work time	
Unit of collection:	Genotype	
Size of collection:	8 species and intraspecific hybrids	
Coll. growth rate:	1 to 10 genotypes/year	
Means of storage:	Live plant clones	
Distribution:	None	
Support source:	Departmental and personal funds	
Current costs:	$1,000/year labor	
Current facilities:	150 ft² greenhouse space	
Long-term needs:	PI for collection	
Status:	Imperiled: no active PI, no funds, no curator	
Limitation:	Everything	

Organism/Collection:	**Vegetables, flowers, and herbs**	**LP4**
Department/Unit:	Agronomy and Range Science/Student Farm	
Usage:	*Research:* Green manure development; *Teaching:* AGR 192, PLS 2; *Service:* Conservation of discontinued cultivars	
Responsible person(s):	T. Chinn (staff)	
Time commitment:	**100% of work time** (is a 50% time employee)	
Unit of collection:	Genotype and/or cultivar	
Size of collection:	300 cultivars	
Coll. growth rate:	30 cultivars/year	
Means of storage:	Live plants and seed	
Distribution:	Distributed to public	
Support source:	Departmental, UC GRCP, and private	
Current costs:	$3,000/year materials, $15,000/year labor	
Current facilities:	100 ft² greenhouse benches, 1.5 ac field, 120 ft³ seed storage	
Long-term needs:	Refrigerated seed storage, permanent curator	
Status:	Endangered, current curator is leaving and funds necessary to fill position are in jeopardy because of budget cuts	
Limitation:	Inadequate space (for storage), inadequate funding (for curator)	

Organism/Collection:	**Davis Arboretum**	**LP5**
Department/Unit:	Davis Arboretum	
Usage:	*Research:* Contribute to projects by 15 to 30 UC Davis faculty/year; *Teaching:* >50 University classes; 10 student interns; public lectures & field trips; guided & unguided tours to 250,000 visitors/year; *Service:* Open to public for research, teaching, & pleasure	
Responsible person(s):	Dr. K. Dawson, Director (0.50 FTE, faculty, Env. Design); W. Roberts, Superintendent (1.00 FTE); M. Burke, Curator (0.50 FTE)	
Time commitment:	100% of work time	
Unit of collection:	Variable, usually species	
Size of collection:	> 2,000 taxa, approximately 30,000 living specimens	
Coll. growth rate:	800 to 1,000 species/year	
Means of storage:	Live plants, cuttings, seeds and propagules	
Distribution:	Plants, seeds, plant parts for campus education & research; exchange with nurseries and other botanic gardens; international seed exchange; plants sold at annual plant fair	
Support source:	University, private, and sale of plants	
Current costs:	$350,000/year	
Current facilities:	>200 ac, 400 ft^2 greenhouse, 65 ft^3 seed storage, 4,000 ft^2 lath house	
Long-term needs:	Full-time curator, additional horticultural grounds staff, more irrigation systems, enlarged headquarters building, full-time education coordinator, collections conservatory	
Status:	Active collections manager and part-time curator; fairly secure funding	
Limitation:	Inadequate funding (for grounds staff and irrigation systems)	

Organism/Collection:	**Wheat and related species**	**LP6**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Cytogenetic, molecular biology, disease and stress resistance, quality improvement, evolution, genetic mapping	
Responsible person(s):	Dr. J. Dvorak	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	2,000 genotypes	
Coll. growth rate:	500/year	
Means of storage:	Refrigerated seed storage	
Distribution:	Internationally by request as funds permit	
Support source:	Departmental funds, no federal support	
Current costs:	$10,000/year–labor	
Current facilities:	Two freezers, 500 ft^2 lab space, 1,200 ft^2 greenhouse space	
Long-term needs:	Two additional freezers (@ $600 each)	
Status:	Active PI, seed viability threatened–poor storage, insufficient support for inventory and maintenance	
Limitation:	Inadequate funding (for inventory, seed increase, and distribution)	

Organism/Collection:	***Phaseolus* spp.**	**LP7**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Measuring diversity and mapping genome; *Teaching:* GGG 221	
Responsible person(s):	Dr. P. Gepts	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	1,317 genotypes	
Coll. growth rate:	200 genotypes/year	
Means of storage:	Seeds kept under refrigerated conditions	
Distribution:	Not regularly	
Support source:	Departmental and other University funds	
Current costs:	$5,000/year for part-time help and supplies	
Current facilities:	700 ft^2 greenhouse, 80 ft^2 refrigerated seed storage, 1,000 ft^2 laboratory	
Long-term needs:	-70°C freezer for storage of clones, more greenhouse space for seed increase, DNA storage facilities	
Status:	Active PI; seeds are not increased at this institution but duplicate collections exist at other institutions	
Limitation:	Inadequate funding (labor)	

Organism/Collection:	***Clarkia* spp. (Onagraceae)**	**LP8**
Department/Unit:	Genetics	
Usage:	*Research:* Molecular and developmental genetics; plant evolution	
Responsible person(s):	Dr. L. Gottlieb	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	**100 popu**lations of 30 species	
Coll. growth rate:	Not growing	
Means of storage:	Seeds stored under refrigerated conditions	
Distribution:	None listed	
Support source:	Federal grants	
Current costs:	Not listed	
Current facilities:	60 ft^3 refrigerated storage	
Long-term needs:	None listed	
Status:	Active PI, no apparent problems, duplicate of part of collection at NSSL	
Limitation:	None listed	

Organism/Collection:	**Peach and almond lines**	**LP9**
Department/Unit:	Pomology	
Usage:	***Research:*** Study of tree and cell physiology, genetic disease resistance, and molecular genetics of *Prunus*; *Teaching:* POM 101, 102; *Service:* Established *Prunus* trees at community housing complex	
Responsible person(s):	Dr. T.M. Gradziel	
Time commitment:	**5% of work time**	
Unit of collection:	Genotype	
Size of collection:	660 genotypes	
Coll. growth rate:	10 genotypes/year	
Means of storage:	Live plant	
Distribution:	**National Peach Br**eeders upon request	
Support source:	Industry donations and some departmental	
Current costs:	$1,000/year materials and 1,000 man hours of labor/year	
Current facilities:	1,000 ft² greenhouse, 2,000 ft² screenhouse (shared), 8 ac field space, 100 ft² refrigerated storage	
Long-term needs:	More greenhouse and work space, quarantine facilities	
Status:	Active PI, but losing departmental funds as land taxes on field space are increasing, so may reduce scope of collection	
Limitation:	Inadequate funding for whole-plant biology in general	

Organism/Collection:	**Almond germplasm**	**LP10**
Department/Unit:	Pomology	
Usage:	***Research:*** Genetic and physiological studies, pollen, variety testing, virus testing	
Responsible person(s):	Dr. T.M. Gradziel; Dr. D. Kester (retired)	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	45 genotypes	
Coll. growth rate:	Not growing; future expansion planned	
Means of storage:	Live plant	
Distribution:	No distribution	
Support source:	**Departmental** and industry funds	
Current costs:	Est. maintenance costs $200/acre/year, total: $1,000	
Current facilities:	5 ac field space, 10 ft³ refrigerated nut storage space	
Long-term needs:	Labor for field maintenance	
Status:	Active PI, collection not currently in danger	
Limitation:	Inadequate funding (labor for maintenance), protection from viruses in field	

Organism/Collection:	**EH Botanic gardens**	**LP11**
Department/Unit:	Environmental Horticulture	
Usage:	*Research:* Used by 10 to 15 faculty members, projects too numerous to list; *Teaching:* ENH 6, 10, 105, 107, 125, 130, 133, PLS 102, 112; *Service:* Open to public, samples distributed to public	
Responsible person(s):	Dr. J. Harding	
Time commitment:	10% of work time	
Unit of collection:	No single unit (too diverse a collection)	
Size of collection:	600 species or cultivars	
Coll. growth rate:	50 specimens/year	
Means of storage:	Live plants	
Distribution:	Internationally distributed as funds permit	
Support source:	Departmental	
Current costs:	$25,000 to 30,000/year	
Current facilities:	2 ac field space, 1,000 ft^2, 3 ft^3 refrigerated storage	
Long-term needs:	Additional field space, additional and modernized greenhouse space	
Status:	Active PI, not currently in danger	
Limitation:	Inadequate facilities (field and greenhouse), inadequate funding (maintenance)	

Organism/Collection:	***Gerbera* genepool**	**LP12**
Department/Unit:	Environmental Horticulture	
Usage:	*Research:* Breeding and quantitative genetics for cultivar release; *Service:* Seed distribution to public	
Responsible person(s):	Dr. J. Harding	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	500 genotypes in a population as separate plants	
Coll. growth rate:	Not growing	
Means of storage:	Seeds, cuttings, and tissue samples stored under refrigerated conditions	
Distribution:	Distributed to research institutions	
Support source:	Departmental and private donations	
Current costs:	$5,000 to 10,000/year	
Current facilities:	2,000 ft^2 greenhouse, 3 ft^3 refrigerated storage	
Long-term needs:	Modernized greenhouse space	
Status:	Active PI, collection in danger of abandonment due to cut-back of departmental funds	
Limitation:	Inadequate facilities (greenhouse), inadequate funding	

Organism/Collection:	**Cereal grains (barley, wheat, triticale, oats)**	**LP13**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Selection for production potential, disease and stress resistance, and grain quality, cultivar release	
Responsible person(s):	Dr. L. Jackson	
Time commitment:	5% of work time	
Unit of collection:	Breeding line	
Size of collection:	210 breeding lines	
Coll. growth rate:	60 lines/year	
Means of storage:	Seeds stored under refrigerated conditions	
Distribution:	Distribution to private US breeding programs	
Support source:	University and private funds	
Current costs:	$50/year materials, Funds for 5 hours/wk labor	
Current facilities:	6 ac field space, 150 ft² refrigerated seed storage	
Long-term needs:	Need additional freezer space	
Status:	Active PI, some danger to collection due to uncertain future budget	
Limitation:	Inadequate facilities (freezer space)	

Organism/Collection:	**Experimental crops–Grain *Amaranthus* and rose clover**	**LP14**
Department/Unit:	Agronomy and Range Science	
Usage:	New collection, not currently in use	
Responsible person(s):	Dr. S. Jain	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	New collection, not yet organized	
Coll. growth rate:	Growing rapidly	
Means of storage:	Seeds stored at room temperature	
Distribution:	Not yet distributed	
Support source:	Departmental	
Current costs:	Approx. $4,000/year	
Current facilities:	80 ft² storage space	
Long-term needs:	Field space for seed increase	
Status:	Active PI, but no funds for labor to organize collection and grow seeds out for increase; seeds will not remain viable in unrefrigerated conditions very long	
Limitation:	Inadequate funding (labor)	

Organism/Collection:	***Limnanthes* spp. (Meadowfoam)**	**LP15**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Domestication of *Limnanthes* (germplasm collection, evaluation, etc.)	
Responsible person(s):	Dr. S. Jain	
Time commitment:	5% of work time	
Unit of collection:	Accession	
Size of collection:	70+ accessions	
Coll. growth rate:	30 accessions/year	
Means of storage:	Seeds stored at room temperature	
Distribution:	Internationally upon request	
Support source:	Departmental	
Current costs:	$5,000/year which includes travel and cost of 1 part-time employee	
Current facilities:	1,000 ft² greenhouse space, 80 ft² storage space	
Long-term needs:	Long-term financial commitment	
Status:	Active PI but no funds for labor; cannot maintain for long term	
Limitation:	Inadequate funding (labor)	

Organism/Collection:	**Helianthae germplasm**	**LP16**
Department/Unit:	Botany	
Usage:	*Research:* Biosystematic and molecular genetic studies; *Teaching:* BOT 100, 256A,B; *Service:* Work with horticulture societies	
Responsible person(s):	Dr. D. Kyhos	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	736 genotypes	
Coll. growth rate:	50 to 75 accessions/year	
Means of storage:	Live plants and seeds under refrigerated and unrefrigerated conditions	
Distribution:	Distributed on request for research	
Support source:	Departmental and private funds	
Current costs:	$50/year materials, 4 hours/wk labor	
Current facilities:	750 ft² greenhouse space, 10 ft² refrigerated storage space, 5 ft² storage space	
Long-term needs:	Separate refrigerator for collection only	
Status:	Active PI, most of collection replicated in Honolulu collection	
Limitation:	Inadequate facilities (greenhouse and refrigerator)	

Organism/Collection:	**Rice germplasm**	**LP17**
Department/Unit:	Agronomy and Range Science/USDA-ARS	
Usage:	*Research:* Study of rice genetics, improvement of desirable traits	
Responsible person(s):	Dr. D. MacKill	
Time commitment:	5% of work time	
Unit of collection:	Accession	
Size of collection:	1,000 accessions	
Coll. growth rate:	50 to 100 accessions/year	
Means of storage:	Seeds stored under refrigerated conditions	
Distribution:	None yet, but is a new collection	
Support source:	USDA and private donations	
Current costs:	$5,000/year for supplies and labor	
Current facilities:	200 ft² greenhouse space, 0.5 ac, 400 ft² refrigerated seed storage, 720 ft² laboratory space	
Long-term needs:	Additional laboratory space	
Status:	Active PI, adequate funding, collection not currently in danger	
Limitation:	Inadequate facilities (seed storage space dedicated to collection)	

Organism/Collection:	**Walnut collection**	**LP18**
Department/Unit:	Pomology	
Usage:	*Research:* Study of apomixis, flower abscission, codling moth resistance, DNA markers, aflatoxin production, and breeding of desirable traits; *Service:* Work with California walnut growers	
Responsible person(s):	Dr. G. McGranahan	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	Collection size changing radically in near future	
Coll. growth rate:	Not growing	
Means of storage:	Live plants	
Distribution:	Internationally distributed upon request	
Support source:	Departmental	
Current costs:	$6,000/year	
Current facilities:	4 ac field space	
Long-term needs:	2 additional acres, stable source of funding	
Status:	Active PI, but much of the walnut collection will be discarded by 1993 due to lack of grower and departmental interest	
Limitation:	Inadequate space, inadequate funding	

Organism/Collection:	***Anthoceros punctatus* (hornwort) and symbiotic *Nostoc* spp. (Cyanobacteria)**	**LP19**
Department/Unit:	Microbiology	
Usage:	*Research:* Study of physiology of symbiotic systems, chemical signals	
Responsible person(s):	Dr. J. Meeks	
Time commitment:	5% of work time	
Unit of collection:	Entire collection of hornwort and cyanobacteria, all clones	
Size of collection:	One hornwort species, approximately 48 strains of diazotrophic cynobacteria and 33 mutant strains	
Coll. growth rate:	Hornwort not growing, cyanobacteria growing by about 15 strains/year	
Means of storage:	Live plants and frozen at -80°C	
Distribution:	Internationally distributed upon request	
Support source:	NSF grant	
Current costs:	$5,000/year labor and $1,000/year supplies	
Current facilities:	1,000 ft² laboratory	
Long-term needs:	Need more freezer space	
Status:	Active PI, adequate funding; collection not currently in danger	
Limitation:	Inadequate funding (labor)	

Organism/Collection:	**Lettuce germplasm**	**LP20**
Department/Unit:	Vegetable Crops	
Usage:	*Research:* Breeding for resistance to pathogens using transgenic plants, characterization and mapping of genes, breeding new cultivars for commercial release; *Teaching:* VCR 220	
Responsible person(s):	Dr. R. Michelmore; Dr. O. Ochoa (staff)	
Time commitment:	5% of work time	
Unit of collection:	Line	
Size of collection:	5,000 lines representing 8 species	
Coll. growth rate:	10 to 20% of total each year	
Means of storage:	Seeds stored under refrigerated conditions	
Distribution:	Internationally upon request	
Support source:	Departmental, grants, and private donations	
Current costs:	$21,900/year labor and materials	
Current facilities:	3,000 ft² greenhouse space, 0.5 ac field space, 830 ft² laboratory space	
Long-term needs:	Need more greenhouse space and low temperature freezers	
Status:	Active PI, marginally adequate funding, no expansion possible, seeds must be moved to low temperature freezers for long term storage	
Limitation:	Inadequate funding (labor), inadequate space (freezer storage)	

Organism/Collection:	***Petunia* germplasm**	**LP21**
Department/Unit:	Environmental Horticulture	
Usage:	*Research:* Genetics of plant growth and flower color; *Service:* Work with California growers	
Responsible person(s):	Dr. C. Napoli; Dr. R. Jorgenson	
Time commitment:	5% of work time	
Unit of collection:	Line	
Size of collection:	21 lines (cultivated, wild, inbred, and mutant)	
Coll. growth rate:	40 lines/year	
Means of storage:	Live plants and seeds at room temperature	
Distribution:	Nationally upon request	
Support source:	Departmental	
Current costs:	$1,000/year materials and 20% FTE	
Current facilities:	25 ft^2 greenhouse space, 30 ft^3 seed storage, 100 ft^2 laboratory space	
Long-term needs:	More greenhouse space	
Status:	Active PIs, adequate funding, collection is not currently in danger	
Limitation:	None yet (is still a young collection)	

Organism/Collection:	**Pistachio germplasm**	**LP22**
Department/Unit:	Pomology	
Usage:	*Research:* Breeding of desirable traits, study of carbon and nitrogen in the plant	
Responsible person(s):	Dr. D. Parfitt	
Time commitment:	5% of work time	
Unit of collection:	Line or species	
Size of collection:	40 lines or species	
Coll. growth rate:	1 line/year	
Means of storage:	Live plants	
Distribution:	Not distributed	
Support source:	Private grants	
Current costs:	$2,000 to 4,000/year	
Current facilities:	5 ac field space	
Long-term needs:	None listed	
Status:	Active PI, adequate funding, not currently in danger	
Limitation:	None listed	

Organism/Collection:	**Wild apricot germplasm**	**LP23**
Department/Unit:	Pomology	
Usage:	***Research:*** Fruit evaluation, use of PCR in evolutionary studies	
Responsible person(s):	Dr. D. Parfitt	
Time commitment:	**5% of work time**	
Unit of collection:	Accession	
Size of collection:	500 accessions	
Coll. growth rate:	Not growing	
Means of storage:	Live plants	
Distribution:	Not distributed	
Support source:	Departmental	
Current costs:	$2,000 to 4,000/year	
Current facilities:	**2 ac field space**	
Long-term needs:	None listed	
Status:	**Active PI,** threatened, funding has been terminated	
Limitation:	Inadequate funding	

Organism/Collection:	**Conservatory plants**	**LP24**
Department/Unit:	Botany	
Usage:	*Research:* IPM program development, systematics research, provide specimens for many other projects; *Teaching:* Agron. 1 class, Biochem. 1 class, Botany 10 classes, Design 2 classes, Ento. 1 class, Env. Tox. 1 class, Env. Hort. 2 classes, Internship program	
Responsible person(s):	Dr. R. Pearcy; T. Metcalf (staff)	
Time commitment:	0.6 FTE SRA, 0.3 FTE Nursery Tech., 1.0 FTE Student, 0.4 FTE Volunteer	
Unit of collection:	Species or, in a few cases, collection, variety, or cultivar of a single species	
Size of collection:	2,500 species	
Coll. growth rate:	50 species/year	
Means of storage:	Live plants in greenhouse, seed stored under refrigerated conditions	
Distribution:	Internationally distributed as upon request	
Support source:	Departmental	
Current costs:	$38,800/year labor, $2,500/year materials	
Current facilities:	5,000 ft^2 greenhouse space, 7,000 ft^2 field space, 20 ft^3 refrigerated seed storage, 750 ft^2 work space	
Long-term needs:	Double the greenhouse space	
Status:	Active curator, adequate funding, potentially at risk due to departmental re-organization	
Limitation:	Inadequate space	

Organism/Collection:	**Barley and wheat germplasm**	**LP25**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Breeding and improvement of current cultivars	
Responsible person(s):	Dr. P. Puri	
Time commitment:	5% of work time	
Unit of collection:	Line	
Size of collection:	3,000 lines of wheat and barley	
Coll. growth rate:	Variable	
Means of storage:	Seeds stored under refrigerated conditions	
Distribution:	International distribution on request	
Support source:	Departmental and private funds	
Current costs:	$7,000/year	
Current facilities:	5 ac field space, 500 ft^3 seed storage	
Long-term needs:	Additional greenhouse space and low temperature freezer	
Status:	Active PI, threatened, inadequate funding	
Limitation:	Inadequate funding	

Organism/Collection:	**Cereals collection–Wheat, triticale, and oats**	**LP26**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Characterization and improvement of genetic traits; *Teaching:* AGR 111	
Responsible person(s):	Dr. C.O. Qualset	
Time commitment:	5% of work time	
Unit of collection:	Accession or line	
Size of collection:	5,000 triticale acc., 15,200 wheat acc., 500 oat acc.	
Coll. growth rate:	50 to 100 accessions/year	
Means of storage:	Seeds and genomic DNA stored under refrigerated and unrefrigerated conditions	
Distribution:	Internationally distributed upon request	
Support source:	Federal and private grants	
Current costs:	$20,000/year labor, $5,000/year materials	
Current facilities:	5 ac field space, 500 ft^2 greenhouse space, 2,400 ft^3 unrefrigerated seed storage, 1,000 ft^3 refrigerated seed storage, 500 ft^2 work space.	
Long-term needs:	Additional greenhouse space, additional refrigerated seed storage, better pest control in seed storage	
Status:	Active PI, adequate funding, not currently in danger	
Limitation:	Inadequate space	

Organism/Collection:	***Brassica* germplasm**	**LP27**
Department/Unit:	Vegetable Crops	
Usage:	*Research:* Genome evolution and molecular cytogenetics	
Responsible person(s):	Dr. C. Quiros	
Time commitment:	5% of work time	
Unit of collection:	Accession, line, genotype	
Size of collection:	1,600 items	
Coll. growth rate:	Variable	
Means of storage:	Seeds stored at 4°C and controlled humidity, DNA stored under refrigerated conditions	
Distribution:	Limited to few seeds	
Support source:	Departmental and Federal grants	
Current costs:	$15,000	
Current facilities:	20 ft² refrigerated storage space, 1 shelf laboratory controlled storage space.	
Long-term needs:	None listed	
Status:	Active PI, adequate funding, not currently in danger	
Limitation:	Inadequate funding (for increase and distribution)	

Organism/Collection:	**Tomato Genetics Resource Center**	**LP28**
Department/Unit:	Vegetable Crops	
Usage:	*Research:* Characterization and improvement of genetic traits, construction of genetic linkage map, introgression of traits from wild to cultivated sp.; *Teaching:* Veg. Crops (3 classes), Nem (1 class), Pl. Sci (1 class); *Service:* 2 Extension courses	
Responsible person(s):	Dr. C. Rick (retired); R. Chetelat (staff)	
Time commitment:	100% of work time for each	
Unit of collection:	Accession	
Size of collection:	2,850 accessions	
Coll. growth rate:	Approx. 100 accessions/year	
Means of storage:	Seeds stored under refrigerated, dehumidified conditions	
Distribution:	Internationally distributed upon request	
Support source:	University, federal, and private grants	
Current costs:	$60,000/year labor, $6,000/year materials, $11,000/year additional expenses	
Current facilities:	2 ac field space, 700 ft² laboratory space, 3,000 ft² greenhouse space, 650 ft³ refrigerated seed storage space in shared facility	
Long-term needs:	Seed storage space dedicated to the collection	
Status:	Active curator, adequate funding, collection not currently in danger	
Limitation:	Inadequate funding (labor), inadequate facility for seed storage	

Organism/Collection:	*Castanea* germplasm	LP29
Department/Unit:	Pomology	
Usage:	*Research:* Variety evaluations, post-harvest storage and handling requirements, quality and production procedures; *Service:* Work with county extension specialists	
Responsible person(s):	Dr. K. Ryugo (retired); Dr. R. Romani	
Time commitment:	5% of work time	
Unit of collection:	Clone	
Size of collection:	100 clones	
Coll. growth rate:	Not growing	
Means of storage:	Live plants	
Distribution:	Minimally distributed	
Support source:	Departmental	
Current costs:	$1,000/year	
Current facilities:	1 ac field space	
Long-term needs:	Additional funding	
Status:	Threatened, retired PI, lack of industry organization, inadequate funding	
Limitation:	No active investigator, inadequate funding (maintenance)	

Organism/Collection:	*Alstroemeria* germplasm	LP30
Department/Unit:	Environmental Horticulture	
Usage:	New collection, not currently used for research or teaching	
Responsible person(s):	Dr. R. Sachs	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	100 genotypes	
Coll. growth rate:	Not growing	
Means of storage:	Live plants and rhizomes in greenhouse and field	
Distribution:	Not currently distributed	
Support source:	Departmental	
Current costs:	$2,000/year	
Current facilities:	250 ft² greenhouse space, 0.5 ac field space, 1 ft³ refrigerated seed storage, 250 ft² laboratory space	
Long-term needs:	Additional greenhouse space, additional funding	
Status:	Active PI, inadequate funding	
Limitation:	Inadequate funding (personnel)	

Organism/Collection:	***Eucalyptus* germplasm**	**LP31**
Department/Unit:	Environmental Horticulture	
Usage:	*Research:* Breeding for freezing and salt tolerance; *Teaching:* PLS 102; *Service:* Work with Soil Conservation Service, timber companies	
Responsible person(s):	Dr. R. Sachs	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	30 genotypes	
Coll. growth rate:	Not growing	
Means of storage:	Live plants	
Distribution:	Nationally distributed upon request	
Support source:	Private grant	
Current costs:	$1,000/year	
Current facilities:	0.5 ac field space, 1 ft^3 refrigerated seed storage, 250 ft^2 laboratory space	
Long-term needs:	Financial support for personnel	
Status:	Active PI, inadequate funding for labor but not currently in danger	
Limitation:	Inadequate funding	

Organism/Collection:	**Pecan germplasm**	**LP32**
Department/Unit:	Pomology	
Usage:	Collection not currently in use	
Responsible person(s):	Dr. G.S. Sibbett; Dr. G. McGranahan	
Time commitment:	5% of work time	
Unit of collection:	Clone	
Size of collection:	23 clones	
Coll. growth rate:	Not growing	
Means of storage:	Live plants	
Distribution:	Not currently distributed	
Support source:	Departmental	
Current costs:	$3,000/year	
Current facilities:	3 ac field space	
Long-term needs:	Curator and funding	
Status:	No active PI, impending loss of funding, collection will be abandoned within the year	
Limitation:	Inadequate funding, inadequate departmental interest	

Organism/Collection:	**Apricot and cherry germplasm**	**LP33**
Department/Unit:	Pomology	
Usage:	*Research:* Breeding for disease and insect resistance, characterization of fruit traits	
Responsible person(s):	Dr. S. Southwick	
Time commitment:	5% of work time	
Unit of collection:	Clone	
Size of collection:	400 populations	
Coll. growth rate:	10 to 20 populations/year	
Means of storage:	Live plants	
Distribution:	Distributed to private industry	
Support source:	Industry funds	
Current costs:	Not listed	
Current facilities:	3 ac field space	
Long-term needs:	Additional field space, labor, and funds for operational expenses	
Status:	Active PI, many clones may be abandoned due to lack of funding	
Limitation:	Inadequate funding	

Organism/Collection:	**Tomato germplasm**	**LP34**
Department/Unit:	Vegetable Crops	
Usage:	*Research:* Breeding for fruit improvement, disease resistance, and stress tolerance, introgression of wild germplasm; *Teaching:* PLS 113	
Responsible person(s):	Dr. D. St.Clair	
Time commitment:	5% of work time	
Unit of collection:	Accession	
Size of collection:	5,000 to 10,000 accessions	
Coll. growth rate:	500 to 1,000 accessions/year	
Means of storage:	Whole plants and seeds, pollen, and DNA stored under refrigerated conditions	
Distribution:	Internationally distributed upon request	
Support source:	Departmental, state and private funding	
Current costs:	$100,000/year labor, materials, and greenhouse space	
Current facilities:	5 ac field space, 4,000 ft^2 greenhouse space, 90 ft^3 refrigerated storage, 1,600 ft^2 laboratory space	
Long-term needs:	Additional isolation greenhouse and halogen lighting	
Status:	Active PI, adequate funding, collection not currently in danger	
Limitation:	Inadequate facilities (greenhouse space)	

Organism/Collection:	***Medicago* species germplasm**	**LP35**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Study of pollination, N_2 fixation, forage quality, disease resistance, and drought tolerance; *Teaching:* AGR 199, 221, and 299	
Responsible person(s):	Dr. L.R. Teuber	
Time commitment:	5% of work time	
Unit of collection:	Population	
Size of collection:	1,150 populations	
Coll. growth rate:	25 populations/year	
Means of storage:	Seeds stored at low humidity	
Distribution:	Internationally distributed as requested	
Support source:	Departmental and private funding	
Current costs:	Cost of 1/3 time staff + materials	
Current facilities:	1 ac field space, 300 ft² greenhouse space, a portion of departmental seed storage space	
Long-term needs:	Additional refrigerated storage, seed cleaning facilities, bee cages for controlled pollinations	
Status:	Active PI, adequate funding, collection not currently in danger	
Limitation:	Inadequate facilities, inadequate funding (for facility improvement)	

Organism/Collection:	**Grape germplasm**	**LP36**
Department/Unit:	Viticulture and Enology	
Usage:	*Research:* Viticulture production, breeding and germplasm maintenance, DNA characterization; *Teaching:* VEN 101A,B,C, 116, 123, 124, 125, 126; *Service:* Classes for general public	
Responsible person(s):	Dr. A. Walker	
Time commitment:	5% of work time	
Unit of collection:	Clone	
Size of collection:	400 clones	
Coll. growth rate:	50 clones/year	
Means of storage:	Live plants	
Distribution:	Nationally distributed upon request	
Support source:	Departmental and Federal funding	
Current costs:	Cost of 1 FTE, $1,000/year for materials	
Current facilities:	20 ac field space, 6,000 ft² greenhouse space	
Long-term needs:	Additional greenhouse space	
Status:	Active PI, impending funding loss may threaten collection	
Limitation:	Inadequate funding (personnel)	

Organism/Collection:	**Euphorbiaceae (esp. *Dalechampia, Euphorbia, Jatropha*)**	**LP37**
Department/Unit:	Botany	
Usage:	*Research:* Systematics	
Responsible person(s):	Dr. G.L. Webster	
Time commitment:	5% of work time	
Unit of collection:	Species	
Size of collection:	*Dalechampia* (20 species); *Euphorbia* (15 species); *Jatropha* (15 species)	
Coll. growth rate:	Static	
Means of storage:	Live plants in greenhouse	
Distribution:	Species of *Jatropha* to Univ. of Florida	
Support source:	Departmental	
Current costs:	$1,000/year for time and materials	
Current facilities:	1,500 ft² greenhouse space	
Long-term needs:	Funding and personnel	
Status:	Active PI	
Limitation:	Inadequate funding (operations and personnel)	

Organism/Collection:	**Cotton germplasm**	**LP38**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Molecular studies of cotton genetics; *Teaching:* PLS 198	
Responsible person(s):	Dr. T. Wilkins	
Time commitment:	5% of work time	
Unit of collection:	Genotype	
Size of collection:	Not listed	
Coll. growth rate:	50 genotypes/year	
Means of storage:	Live plants and seeds at room temperature, DNA stored under refrigerated conditions	
Distribution:	New collection, not currently distributed	
Support source:	Private grants	
Current costs:	$3,000 to 4,000/year materials and greenhouse rental, labor not listed	
Current facilities:	760 ft² greenhouse space, 1,000 ft² laboratory space	
Long-term needs:	Additional greenhouse space, tissue culture facilities	
Status:	Active PI, adequate funding, collection not currently in danger	
Limitation:	Inadequate facilities (environmental control)	

Organism/Collection:	**Mediterranean legume germplasm**	**LP39**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research*	
Responsible person(s):	Dr. W.A. Williams; Dr. W.L. Graves	
Time commitment:	5% of work time	
Unit of collection:	Accession	
Size of collection:	743 accessions	
Coll. growth rate:	700 accessions/year	
Means of storage:	Seeds stored in refrigerated and unrefrigerated conditions	
Distribution:	Nationally distributed upon request	
Support source:	University and Federal funding	
Current costs:	$5,000/year	
Current facilities:	15 ft^2 refrigerated and 15 ft^2 unrefrigerated conditions	
Long-term needs:	Additional storage	
Status:	Active PI, adequate funding for storage but inadequate funding for seed increase; collection will eventually become inviable	
Limitation:	Inadequate funding (personnel for inventory and maintenance)	

Organism/Collection:	**Buffalo grass germplasm**	**LP40**
Department/Unit:	Environmental Horticulture	
Usage:	*Research:* Testing for sod and seed production; *Teaching:* ENH 130; *Service:* Work with seed and sod farmers	
Responsible person(s):	Dr. L. Wu	
Time commitment:	5% of work time	
Unit of collection:	Line	
Size of collection:	22 lines	
Coll. growth rate:	5 lines/year	
Means of storage:	Live plants, seeds and DNA stored under refrigerated conditions	
Distribution:	Nationally distributed upon request	
Support source:	Departmental and private funding	
Current costs:	$4,000/year materials, cost of 50% Research Assistant	
Current facilities:	2 ac field space, 600 ft^2 greenhouse space, 300 ft^2 refrigerated storage, 150 ft^2 laboratory space	
Long-term needs:	Field facilities and equipment	
Status:	Active PI, adequate funding, not currently in danger	
Limitation:	Inadequate facilities (low temperature storage space)	

Organism/Collection:	**National Germplasm Repository**	**LP41**
Department/Unit:	National Clonal Germplasm Repository	
Usage:	*Research:* Evaluation and characterization of genetic traits, improved methods of genetic resources maintenance; *Teaching:* PLS 113	
Responsible person(s):	Dr. K. Rigert	
Time commitment:	**100% of work** time	
Unit of collection:	Clone	
Size of collection:	**4,300** accessions representing grape, stone fruits, walnut, pistachio, olive, fig, kiwi, persimmon, pomegranate, and mulberry	
Coll. growth rate:	300 accessions/year	
Means of storage:	Live plants	
Distribution:	Internationally distributed upon request	
Support source:	Federal funding	
Current costs:	$322,000/year	
Current facilities:	**70 ac field space, 2,400 ft² greenhouse** space, 1,600 ft² lath house space, 1,280 ft² laboratory space, 3,600 ft² insect-proof screenhouse	
Long-term needs:	Additional labor	
Status:	Active curator, adequate funding, collection not currently in danger	
Limitation:	Inadequate funding (labor)	

Organism/Collection:	**California weedy rye populations**	**LP42**
Department/Unit:	Agronomy and Range Science	
Usage:	*Research:* Population genetics, forage rye breeding	
Responsible person(s):	Staff	
Time commitment:	None	
Unit of collection:	Population	
Size of collection:	6 populations, 50 individuals per population	
Coll. growth rate:	Not growing	
Means of storage:	Seed in boxes	
Distribution:	International distribution upon request	
Support source:	Departmental	
Current costs:	No current cost	
Current facilities:	Storage box	
Long-term needs:	Regeneration	
Status:	No active PI, not currently in danger	
Limitation:	Inadequate departmental interest	

Summary of preserved collections

Organism/Collection:	**Bohart Museum of Entomology**	**P1**
Department/Unit:	Entomology	
Usage:	*Research:* Systematic and behavioral studies; *Teaching:* ENT 10, 100, 106, 107, 111, 147. BIS 1; *Service:* Identifications, exhibits for public, tours	
Responsible person(s):	Dr. L. Kimsey	
Time commitment:	10% of work time	
Unit of collection:	Species, colony, or individual	
Size of collection:	6,000,000 specimens, 9th largest in US	
Coll. growth rate:	20,000 to 50,000 specimens/year	
Means of storage:	Insects are cryogenically preserved, dried and mounted, or alcohol preserved	
Distribution:	No distribution of materials, but loan materials internationally	
Support source:	Departmental, private, and federal funds	
Current costs:	$35,000/year	
Current facilities:	3,500 ft^3 cabinet storage space, 4 ft^3 cryogenic freezer space, 100 ft^2 laboratory space	
Long-term needs:	Ultra cold freezer, more storage space, mobile compactor shelving	
Status:	Active curator, not currently in danger	
Limitation:	Inadequate facilities (storage space)	

Organism/Collection:	**Ant (Formicidae) collection**	**P2**
Department/Unit:	Entomology	
Usage:	*Research:* Systematics of the ant family; *Teaching:* ENT 103, 105; *Service:* Work with California Nature Conservancy	
Responsible person(s):	Dr. P. Ward	
Time commitment:	5% of work time	
Unit of collection:	Colony	
Size of collection:	8,550 colonies representing 3,000 species and 150 genera	
Coll. growth rate:	660 accessions/year	
Means of storage:	Whole animals preserved in 95% ethanol	
Distribution:	Internationally distributed as number of specimens permit	
Support source:	Departmental and Federal funding	
Current costs:	$2,000/year labor, $200/year materials	
Current facilities:	20 ft^2 storage space	
Long-term needs:	Refrigerated storage	
Status:	Active PI, adequate funding, collection not currently in danger	
Limitation:	Inadequate facilities (storage space)	

Organism/Collection:	**Parasite collection**	**P3**
Department/Unit:	Vet Med/Microbiology and Immunology	
Usage:	*Research:* Taxonomic studies, disease vectoring of ticks and mites on wild ungulates and dogs; *Teaching:* VMD 405 (Parasitology); *Service:* Work with California farms	
Responsible person(s):	R. Houston (staff)	
Time commitment:	10% of work time	
Unit of collection:	Species	
Size of collection:	Approx. 1,200 preserved specimens	
Coll. growth rate:	Approx. 50 specimens/year	
Means of storage:	Animals preserved in formalin and ethanol or dried and mounted	
Distribution:	Not distributed (is used primarily in teaching, diagnostics, and research within department)	
Support source:	Departmental	
Current costs:	$2,500 to 3,000/year for materials and salary	
Current facilities:	500 ft² storage space	
Long-term needs:	Need computer to log accession information in database	
Status:	Active PI, collection not currently in danger, but lacks accessibility to campus use without computerized data management	
Limitation:	Collection cannot be moved; must be near teaching labs; records on paper only	

Organism/Collection:	**John M. Tucker Herbarium**	**P4**
Department/Unit:	Botany	
Usage:	*Teaching:* Several courses; *Service:* Specimens loaned as reference, plant identification service to public, consultation on environmental matters	
Responsible person(s):	Dr. G.L. Webster	
Time commitment:	15% of work time	
Unit of collection:	Specimen	
Size of collection:	118,000 specimens	
Coll. growth rate:	5,000 specimens/year	
Means of storage:	Dried and mounted	
Distribution:	Specimens are distributed on a loan basis to scientists worldwide	
Support source:	Departmental	
Current costs:	$1,500/year for supplies, $5,000/year for personnel (includes Crampton collections)	
Current facilities:	1,700 ft², includes space for a library and word processor	
Long-term needs:	$25,000/year operations budget, minimum of 5,000 ft², compactor cabinet system	
Status:	Not currently threatened	
Limitation:	Inadequate space	

Organism/Collection:	**Beecher Crampton herbarium collection**	P5
Department/Unit:	Botany	
Usage:	*Teaching:* Several courses; *Service:* Specimens loaned as reference, plant identification service to public, consultation on environmental matters	
Responsible person(s):	Dr. G.L. Webster	
Time commitment:	5% of work time	
Unit of collection:	Specimen	
Size of collection:	35,000 specimens	
Coll. growth rate:	Not growing	
Means of storage:	Dried and mounted	
Distribution:	Specimens are distributed on a loan basis to scientists worldwide	
Support source:	Departmental	
Current costs:	Subsumed under Tucker Herbarium (see P4)	
Current facilities:	Kept with the Tucker Herbarium (see P4)	
Long-term needs:	See Tucker Herbarium (P4), 20 7'x3'x1' cabinets for storage	
Status:	Not currently threatened	
Limitation:	Inadequate space	

Organism/Collection:	**Andrew T. Leiser herbarium collection**	P6
Department/Unit:	Environmental Horticulture	
Usage:	*Teaching:* ENH 6, 105, 107, 115, 299	
Responsible person(s):	Dr. J.A. Harding	
Time commitment:	5% of work time	
Unit of collection:	Specimen	
Size of collection:	11,000 specimens	
Coll. growth rate:	Not growing	
Means of storage:	Dried and mounted	
Distribution:	Specimens are distributed on a loan basis to scientists worldwide	
Support source:	Departmental	
Current costs:	Not listed	
Current facilities:	Not listed	
Long-term needs:	Not listed	
Status:	Not currently threatened	
Limitation:	Inadequate space	

Organism/Collection:	**UC Davis Nematode collection**	**P7**
Department/Unit:	Nematology	
Usage:	*Research:* Taxonomy, systematics, biodiversity, and control; *Teaching:* Systematics, NEM 100, 220, 225; *Service:* Identification reference for researchers worldwide, CDFA, USDA, farmers	
Responsible person(s):	Dr. S.L. Gardner	
Time commitment:	5% of work time	
Unit of collection:	Accession	
Size of collection:	360,000 accessions	
Coll. growth rate:	3,000 accessions/year	
Means of storage:		
Distribution:	Specimens are distributed on a loan basis to scientists worldwide	
Support source:	Departmental	
Current costs:	$1,000/year supplies	
Current facilities:	210 ft² room	
Long-term needs:	$5,000/year operations budget, 2,000 ft² storage space	
Status:	Not currently threatened	
Limitation:	Inadequate space	

Organism/Collection:	**Mammalian endoparasites**	**P8**
Department/Unit:	Nematology	
Usage:	*Research:* Host/parasite co-evolutionary analyses, conservation biology, historical ecology, biodiversity documentation; *Teaching:* Systematics and co-evolution, NEM 220, 225	
Responsible person(s):	Dr. S.L. Gardner	
Time commitment:	5% of work time	
Unit of collection:	Sample of parasites from single mammalian host	
Size of collection:	6,000 samples	
Coll. growth rate:	1,000 samples/year	
Means of storage:	Frozen, alcohol, and formalin preservation	
Distribution:	Internationally as funds permit	
Support source:	NSF grant	
Current costs:	$11,000 (0.5 FTE), $4,000 (supplies), $22,000 technician/year	
Current facilities:	200 ft² lab, 30 ft² storage, 20 ft³ refrigerated storage	
Long-term needs:	Computer ($2,000), microscope ($15,000), refrigerator ($1,000)	
Status:	Active PI, not currently at risk	
Limitation:	Inadequate space	

Organism/Collection:	**Anthropology ethnographic collections**	**P9**
Department/Unit:	Anthropology	
Usage:	*Research:* Reference for scientists from UCD and other universities and agencies; *Teaching:* ANT 136, 140A,B, 141A,B, 99, 199, DES 24, 126B, 142B and public schools; *Service:* Reference and identification for agencies and museums	
Responsible person(s):	S. Griset (staff)	
Time commitment:	25% of work time	
Unit of collection:	Collection, with varying numbers of specimens	
Size of collection:	63 collections; approx. 3,000 specimens	
Coll. growth rate:	Not currently growing	
Means of storage:	Some controlled humidity, low light space; rest in uncontrolled storage	
Distribution:	Loans to qualified researchers and agencies	
Support source:	Departmental	
Current costs:	0.25 FTE manager's salary, miscellaneous supplies	
Current facilities:	1,400 ft² area with controlled temperature & humidity, low light, secured with alarm; 340 ft² uncontrolled environment, not secured	
Long-term needs:	Operations budget: $5,000/year with other two Anth. collections, space for storage and preparation; equipment	
Status:	Active manager, no operations budget	
Limitation:	Inadequate space, no operations budget, substandard storage conditions	

Organism/Collection:	**Anthropology archaeological collections**	**P10**
Department/Unit:	Anthropology	
Usage:	*Research:* Reference and primary materials; *Teaching:* ANT 3, 176, 183, 184, 99, 199 and public schools; *Service:* Reference and identification for agencies and museums	
Responsible person(s):	S. Griset (staff)	
Time commitment:	75% of work time	
Unit of collection:	Specimen within each accession	
Size of collection:	Approx. 1,000,000 specimens	
Coll. growth rate:	10,000 specimens/year	
Means of storage:	Wooden trays in metal units; archive boxes; deep storage on metal shelves in warehouse	
Distribution:	Loans to qualified researchers and agencies	
Support source:	Departmental	
Current costs:	0.75 FTE manager's salary and miscellaneous supplies	
Current facilities:	966 ft² in 7 storage rooms on campus; 800 ft² in metal warehouse near airport off-campus (deep storage)	
Long-term needs:	Operations budget: $5,000/year with other two Anth. collections, space for storage and preparation; equipment	
Status:	Active manager, no operations budget	
Limitation:	Inadequate space, no operations budget, substandard storage conditions	

Organism/Collection:	**Anthropology biological collections–primate and hominid fossil casts and skeletal materials**	**P11**
Department/Unit:	Anthropology	
Usage:	*Research:* Reference and primary materials; *Teaching:* ANT 1, 151, 152, 154A, 155, 156	
Responsible person(s):	Dr. H. McHenry; Dr. P. Rodman	
Time commitment:	5% of work time	
Unit of collection:	Specimen	
Size of collection:	1,000 specimens	
Coll. growth rate:	Sporadic, as specimens become available	
Means of storage:	Locked, glass-faced cabinets in 2 teaching labs and 1 closet with shelves	
Distribution:	Not distributed	
Support source:	Departmental	
Current costs:	Not given	
Current facilities:	50 ft² in each lab; 100 ft² in closet	
Long-term needs:	Operations budget	
Status:	Active PIs, not currently in danger	
Limitation:	Inadequate space, no operations budget, substandard storage conditions	

Organism/Collection:	**Bodega Marine Laboratory museum collections**	**P12**
Department/Unit:	Bodega Marine Laboratory	
Usage:	*Research:* Reference; *Teaching:* Public display, agencies; *Service:* Identification and reference for agencies	
Responsible person(s):	Dr. P. Connors (staff)	
Time commitment:	Not listed	
Unit of collection:	Specimen	
Size of collection:	2,820; marine mammals, birds, fish, invertebrates, terrestrial and marine plants	
Coll. growth rate:	50 specimens/year	
Means of storage:	Wood and metal cabinets, aquaria	
Distribution:	Not listed	
Support source:	Private donations ($3,000/year), O.5 FTE Museum Scientist, no University operations support	
Current costs:	$3,000/year donations, $5,000/year operations budget, 0.5 FTE personnel	
Current facilities:	340 ft² storage space, 300 ft² exhibit space, 2 30-gal. aquaria	
Long-term needs:	2,000 ft² exhibit space, 864 ft² public education space	
Status:	Not currently in danger	
Limitation:	Inadequate space	

Organism/Collection:	**Geology/paleontology collections**	**P13**
Department/Unit:	Geology	
Usage:	*Research:* Student and faculty; *Teaching:* undergraduate/graduate teaching, most Geology Dept. courses; *Service:* Identifications, public outreach	
Responsible person(s):	Dr. S. Carlson (staff)	
Time commitment:	50% of work time	
Unit of collection:	Specimen/map	
Size of collection:	**10,500 specimens**/2,000 maps	
Coll. growth rate:	100 specimens/year	
Means of storage:	Cabinets, display cases	
Distribution:	Loans made to responsible researchers and educators, primarily within the state	
Support source:	Departmental	
Current costs:	0.50 FTE Research Geologist manager, part-time work-study assistant ($300/year), $500/year operating budget	
Current facilities:	3,500 ft² fragmented among several rooms	
Long-term needs:	1,000 ft² more storage and preparation space, access to research equipment	
Status:	Not currently in danger, no ability to respond to expansion opportunities	
Limitation:	Inadequate space	

Organism/Collection:	**Museum of Wildlife and Fisheries Biology**	**P14**
Department/Unit:	Wildlife and Fisheries Biology	
Usage:	*Research:* Reference and taxonomy; *Teaching:* WFB 10, 100, 102, 110, 111, 111L, 120, 120L, 121, 130, 131, 136, 140, 151, 153, 154, 191 and public outreach programs; *Service:* Identifications	
Responsible person(s):	Dr. R. Cole (staff)	
Time commitment:	50% of work time	
Unit of collection:	Specimen	
Size of collection:	8,000 specimens	
Coll. growth rate:	1,500 specimens/year	
Means of storage:	**Dry-preserved skins,** skulls, skeletons; alcohol-preserved materials	
Distribution:	Loans to other museums, education and conservation programs	
Support source:	Departmental	
Current costs:	**0.50 FTE Mu**seum Scientist as manager, $2,000/year operations	
Current facilities:	1,750 ft² storage, preparation, and office space in three rooms	
Long-term needs:	Total of 2,000 ft² collection space, 200 ft² prep area, fume hood	
Status:	Not currently threatened, space constraints	
Limitation:	Inadequate space	

Organism/Collection:	**Zoology collection**	**P15**
Department/Unit:	Zoology	
Usage:	*Research:* Voucher specimen depository; *Teaching:* ZOO 134, 136, 136L, 137, 137L and public education organizations	
Responsible person(s):	Dr. B. Shaffer	
Time commitment:	10% of work time	
Unit of collection:	Specimen	
Size of collection:	10,000 specimens	
Coll. growth rate:	1 to 3,000 specimens/year	
Means of storage:	Dry-preserved skins, skulls, skeletons; alcohol-preserved materials	
Distribution:	Loans for teaching purposes, campus and agencies	
Support source:	Departmental	
Current costs:	$3,000/year operations budget	
Current facilities:	1,600 ft²	
Long-term needs:	3,500 ft² collection space, 500 ft² prep area, ultracold freezer	
Status:	Not currently threatened, not able to expand	
Limitation:	Inadequate space	

Organism/Collection:	**Primate embryo collection**	**P16**
Department/Unit:	California Primate Research Center	
Usage:	*Research; Teaching*	
Responsible person(s):	Dr. A.G. Hendrickx	
Time commitment:	5% of work time	
Unit of collection:	Specimen	
Size of collection:	500 specimens	
Coll. growth rate:	30 specimens/year	
Means of storage:	Formalin, glass slides	
Distribution:	Used by visiting scientists	
Support source:	National Institutes of Health	
Current costs:	$10,000/year operations budget, 0.50 FTE SRA manager	
Current facilities:	800 ft² space which includes 300 ft² for data storage	
Long-term needs:	Additional 500 ft² within 10 years	
Status:	Not currently threatened	
Limitation:	Inadequate space	

Organism/Collection:	**Axelrod paleobotanical collection**	**P17**
Department/Unit:	Botany	
Usage:	*Research:* Type depository	
Responsible person(s):	Dr. D.I. Axelrod (retired)	
Time commitment:	100% of work time	
Unit of collection:	Specimen	
Size of collection:	50,000 specimens representing 1,000 taxa	
Coll. growth rate:	Growing as research efforts permit; primary types transferred to UC Berkeley	
Means of storage:	Fossilized botanical materials stored in cabinets	
Distribution:	By request, as funds permit	
Support source:	Departmental, private donations, NSF grants, Smithsonian Institution grants	
Current costs:	Not given	
Current facilities:	1,000 ft^2	
Long-term needs:	**Adequate** space and labor	
Status:	Not currently threatened, not able to expand	
Limitation:	Retired faculty, inadequate space	

APPENDIX 2

UC Davis courses that use collections

Courses are listed by department, number, and title, followed by curator/manager–collection name.

Course		Collection
AGR 111	Cereal crops of the world	Qualset–Cereals collection
AGR 192	Internship	Chinn–Vegetables, flowers, & herbs
AGR 199	Special study for advanced undergraduates	Teuber–Medicago germplasm
AGR 221	Advanced plant breeding	Teuber–Medicago germplasm
AGR 299	Research	Teuber–Medicago germplasm
ANS 15	Introductory horse husbandry	Burke et al.–Arboretum
ANS 41	Domestic animal production	Burke et al.–Arboretum
ANS 118	Aquatic animal production	Doroshov–White sturgeon
ANS 123	Animal growth	Bradford/Anderson–Sheep genetic stocks
ANS 131	Reproduction & early development in aquatic animals	Doroshov–White sturgeon
ANS 140	Management of laboratory animals	Bradford et al.–Mouse genetic stocks
ANT 1	Human evolutionary biology	McHenry/Rodman–Anthropology biological collections
ANT 3	Introduction to archaeology	Griset–Anthropology archaeological collections
ANT 99	Special study for undergraduates	Griset–Anthropology archaeological collections Griset–Anthropology ethnographic collections
ANT 136	Visual anthropology	Griset–Anthropology ethnographic collections
ANT 140A	Cultures & societies of West & Central Africa	Griset–Anthropology ethnographic collections
ANT 140	Cultures & societies of East & South Africa	Griset–Anthropology ethnographic collections
ANT 141A	Indians of North America	Griset–Anthropology ethnographic collections
ANT 141C	Ethnography of California & the Great Basin	Griset–Anthropology ethnographic collections
ANT 151	Primate evolution	McHenry/Rodman–Anthropology biological collections
ANT 152	Human evolution & fossil man	McHenry/Rodman–Anthropology biological collections
ANT 154A	The evolution of primate behavior	McHenry/Rodman–Anthropology biological collections
ANT 155	Comparative primate anatomy	McHenry/Rodman–Anthropology biological collections
ANT 156	Human osteology	McHenry/Rodman–Anthropology biological collections
ANT 176	Prehistory of California & the Great Basin	Griset–Anthropology archaeological collections
ANT 183	Laboratory in archeological analysis	Griset–Anthropology archaeological collections
ANT 184	Prehistoric technology: The material aspects of prehistoric adaptations	Griset–Anthropology archaeological collection
ANT 199	Special study for advanced undergraduates	Griset–Anthropology archaeological collection Griset–Anthropology ethnographic collections
AVS 13	Birds, humans, & the environment	Burke et al.–Arboretum
AVS 100	Principles of avian science	Abbott–Avian species Abplanalp–Avian species
AVS 102	Fertility & hatchability	Abbott–Avian species Abplanalp–Avian species
AVS 123	Management of birds	Millam–Parrots

BIS 1B	Introductory biology	Shaffer–Amphibians & Reptiles
BIS 1C	Introductory biology	Lang–Algae collection Larson–Fungi teaching collection Pearcy/Metcalf–Conservatory plants Burke et al.–Arboretum
BOT 2	Introductory survey of botany	Burke et al.–Arboretum
BOT 10	Plants, people, & the biosphere	Larson–Fungi teaching collection Pearcy/Metcalf–Conservatory plants Webster–Tucker Herbarium
BOT 92	Botany conservatory internship	Pearcy/Metcalf–Conservatory plants
BOT 100	**Evolutionary biology of plants**	Kyhos–Helianthae germplasm Pearcy/Metcalf–Conservatory plants
BOT 101	Survey of plant communities of California	Burke et al.–Arboretum Webster–Tucker Herbarium
BOT 102	California floristics	Pearcy/Metcalf–Conservatory plants Burke et al.–Arboretum Webster–Tucker Herbarium
BOT 105	Developmental plant anatomy	Pearcy/Metcalf–Conservatory plants Webster–Tucker Herbarium
BOT 108	**Systematic botany of flowering** plants	Pearcy/Metcalf–Conservatory plants Burke et al.–Arboretum Webster–Tucker Herbarium
BOT 116	Morphology & evolution of vascular plants	Pearcy/Metcalf–Conservatory plants Burke et al.–Arboretum Webster–Tucker Herbarium
BOT 118	Phycology	Lang–Algae collection Webster–Tucker herbarium
BOT 119	Introductory mycology	Larson–Fungi teaching collection
BOT 121	Biology of weeds	Burke et al.–Arboretum
BOT 140	Paleobotany	Pearcy/Metcalf–Conservatory plants
BOT 141	Plant geography	Burke et al.–Arboretum
BOT 192	Botany conservatory internship	Pearcy/Metcalf–Conservatory plants
BOT 245	Pollination ecology	Burke et al.–Arboretum
BOT 255	Principles of plant taxonomy	Burke et al.–Arboretum
BOT 256A	Experimental plant taxonomy	Kyhos–Helianthae germplasm Webster–Tucker herbarium
BOT 256B	Experimental plant taxonomy	Kyhos–Helianthae germplasm Webster–Tucker herbarium
BOT 390	The teaching of botany	Burke et al.–Arboretum
DES 3	Fantasy design	Burke et al.–Arboretum
DES 24	Hand constructed textiles	Griset–Anthropology ethnographic collection
DES 124	Textile structures	Burke et al.–Arboretum
DES 125	Textiles in the landscape	Burke et al.–Arboretum
DES 126B	Visual presentation: Exhibition design	Griset–Anthropology ethnographic collections
DES 142B	World textiles: Middle East, Europe, & the Americas	Griset–Anthropology ethnographic collections
DES 191B	Workshop in design	Burke et al.–Arboretum

Course		Collection
ENT 10	Natural history of insects	L. Kimsey–Bohart Collection
ENT 100	General entomology	Granett/DeBenedictis–Grape *Phylloxera* B. Kimsey–Spirochete collection L. Kimsey–Bohart Collection
ENT 100L	Introductory entomology laboratory	Burke et al.–Arboretum
ENT 101	Functional insect morphology	Peng–Honey Bee Stocks
ENT 103	Insect systematics	Ward–Ant collection
ENT 104	Behavioral ecology of insects	Burke et al.–Arboretum
ENT 106	Field entomology	L. Kimsey–Bohart Collection Burke et al.–Arboretum
ENT 107	California insect diversity	L. Kimsey–Bohart Collection
ENT 109	Field taxonomy & ecology	Burke et al.–Arboretum
ENT 110	Economic entomology	B. Kimsey–Spirochete collection Pearcy/Metcalf–Conservatory plants
ENT 111	Insects & human affairs	L. Kimsey–Bohart Collection
ENT 115	Arthropod management in agriculture	Granett/DeBenedictis–Grape *Phylloxera*
ENT 119	Apiculture	Peng–Honey bee stocks
ENT 120	Insect-host plant interactions	Burke et al.–Arboretum
ENT 135	Introduction to biological control	Burke et al.–Arboretum
ENT 147	Historical biogeography & evolution of biodiversity	L. Kimsey–Bohart Collection
ENT 156	Biology of parasitism	B. Kimsey–Spirochete collection
ENT 219	Advanced apiculture	Peng–Honey bee stocks
ENT 227	Acarology	Burke et al.–Arboretum
ENT 230	Advanced biological control	Burke et al.–Arboretum
ENH 6	Introduction to environmental plants	Harding–EH Botanic Gardens Pearcy/Metcalf–Conservatory plants Burke et al.–Arboretum Webster–Tucker Herbarium
ENH 10	Landscape horticulture for the home & community	Harding–EH Botanic Gardens Burke et al.–Arboretum
ENH 105	Taxonomy & ecology of environmental plants	Harding–EH Botanic Gardens Burke et al.–Arboretum Webster–Tucker Herbarium
ENH 107	Herbaceous environmental plants	Harding–EH Botanic Gardens Pearcy/Metcalf–Conservatory plants Burke et al.–Arboretum Webster–Tucker Herbarium
ENH 115	Advanced taxonomy & ecology of environmental plants	Burke et al.–Arboretum Webster–Tucker Herbarium
ENH 125	Greenhouse & nursery crop production	Harding–EH Botanic Gardens
ENH 130	Turfgrass culture	Harding–EH Botanic Gardens Wu–Buffalo Grass germplasm
ENH 133	Arboriculture	Harding–EH Botanic Gardens Burke et al.–Arboretum
ENH 192	Internship in environmental horticulture	Burke et al.–Arboretum

Course		Collection
ENH 241	Analysis of horticultural problems	Burke et al.–Arboretum
ENH 299	Graduate studies	Webster–Tucker Herbarium
EST 30	The global ecosystem	Burke et al.–Arboretum
ETX 128	Food toxicology	Burke et al.–Arboretum
ETX 200	Mammalian toxicology	Burke et al.–Arboretum
ETX 220L	Analysis of toxicants	Pearcy/Metcalf–Conservatory plants
FST 104L	Food microbiology laboratory	Phaff–Yeast culture collection Shuster–Yeast genetic stocks
GEN 102	Molecular genetics	Green–*Drosophila*
GEO 102	Field course in physical geography	Burke et al.–Arboretum
GEO 105	Cartography	Burke et al.–Arboretum
GEO 106	Aerial photo interpretation & remote sensing	Burke et al.–Arboretum
GEO 107	Advanced cartography	Burke et al.–Arboretum
GEL 1L	Earth laboratory	Burke et al.–Arboretum
GGG 221	Transmission genetics	Gepts–*Phaseolus*
HDE 140L	Laboratory in early childhood	Burke et al.–Arboretum
IAD 101	Tropical crops agriculture	Pearcy/Metcalf–Conservatory plants
LDA 112	Landscape architecture studio: Landscape form, design, & art	Burke et al.–Arboretum
LDA 122	Advanced communication for landscape architecture	Burke et al.–Arboretum
LDA 131	Landscape architecture: Principles of practice	Burke et al.–Arboretum
LDA 155	Plants in the cultural environment	Burke et al.–Arboretum
LDA 156	Landscape planting design	Burke et al.–Arboretum
LDA 159	Public garden management	Burke et al.–Arboretum
LDA 192	Internship in landscape architecture	Burke et al.–Arboretum
LDA 193	Senior project in landscape architecture	Burke et al.–Arboretum
MMI 480B	Pathogenic microbiology	Pappagianis–Pathogenic fungi
MIC 250	Biology of yeasts	Bisson–Yeast genetic stocks
NEM 100	General plant nematology	Jaffee–Nematophagous fungi Burke et al.–Arboretum
NEM 220	Principles and techniques of nematode taxonomy and morphology	Gardner–UCD nematode collection
NEM 222	Advanced plant nematology	Jaffee–Nematophagous fungi
NEM 225	Nematode taxonomy and comparative morphology	Gardner–UCD nematode collection
NEM 240	Biological control in insect & plant nematology	Jaffee–Nematophagous fungi
PHS 121	Physiology of reproduction	Bradford et al.–Mouse genetic stocks
PLP 120	Introduction to plant pathology	Campbell–Plant path. fungi & plant viruses Campbell–Plant path. bacteria Falk–Bacteria & fungi teaching collection Falk–Plant viruses Golino–Grape viruses Kado–Bacteria

		Collection
PLP 226	Plant virology	Bruening–Plant viruses Falk–Plant viruses
PLP 228	Plant bacteriology	Kado–Bacteria
PPP 202A	Diagnosis of plant pest problems & the control of causal agents	Golino–Grape viruses
PLS 2	Production of cultivated plants	Chinn–Vegetables, flowers, & herbs
PLS 102	Physiology of cultivated plants	Harding–EH Botanic Gardens Sachs–*Eucalyptus* germplasm
PLS 109	Plant propagation	Pearcy/Metcalf–Conservatory plants
PLS 112	Postharvest physiology & handling of horticultural commodities	Harding–EH Botanic Gardens
PLS 113	Plant breeding	St.Clair–Tomato germplasm Rigert–NCGR
PLS 198	Directed group study	Wilkins–Cotton germplasm
POM 101	Tree growth & development	Gradziel–Peach & almond
POM 102	Principles of fruit production	Bliss–*Actinidia* Gradziel–Peach & almond
POM 210	Plant reproductive morphology	Bliss–*Actinidia*
RMT 100	Range & wildland plants	Webster–Tucker Herbarium
RSC 2	Concepts in forestry	Burke et al.–Arboretum
RSC 110	Wildflowers of the Central Valley of California	Burke et al.–Arboretum
SOC 46A	Introduction to social research	Burke et al.–Arboretum
SOC 103	Evaluation research methods	Burke et al.–Arboretum
SSC 100	Principles of soil science	Jaffee–Nematophagous fungi Pearcy/Metcalf–Conservatory plants
VCR 220	Biotechnology & genetics of crop improvement	Michelmore/Ochoa–Lettuce germplasm
VMD 405	Veterinary parasitology	Houston–Parasite collection
VMD 413	Medical primatology	Hendrickx–Non-human primates
VMD 445C	Food animal theriogenology	BonDurant–*Tritrichomonas foetus*
VMD 470	Hospital practices	Hendrickx–Non-human primates
VMI 127	Medical bacteria & fungi	Pappagianis–Pathogenic fungi
VEN 101A	Viticultural practices	Walker–Grape germplasm Pearcy/Metcalf–Conservatory plants
VEN 101B	Viticultural practices	Walker–Grape germplasm
VEN 101C	Viticultural practices	Walker–Grape germplasm
VEN 111	World viticulture	Golino–Grape viruses
VEN 116	Winegrape production	Walker–Grape germplasm
VEN 118	Grapevine pests, diseases & disorders	Golino–Grape viruses
VEN 123	Analysis of musts & wines	Walker–Grape germplasm
VEN 124	Wine production	Bisson–Yeast genetic stocks Kunkee et al.–Wine yeast & bacteria Walker–Grape germplasm
VEN 125	Wine types & sensory evaluation	Walker–Grape germplasm

Course		Collection
VEN 126	Wine processing	Walker–Grape germplasm
VEN 217	Microbiology of wine production	Kunkee et al.–Wine yeast & bacteria
WFB 10	Wildlife ecology & conservation	Burke et al.–Arboretum Cole–Museum of WFB
WFB 100	Field methods in wildlife biology	Cole–Museum of WFB
WFB 102	Field studies in fisheries biology	Cole–Museum of WFB
WFB 110	Mammalian biology & ecology	Cole–Museum of WFB
WFB 111	Biology & management of wild birds	Burke et al.–Arboretum Cole–Museum of WFB
WFB 111L	Laboratory in biology & management of wild birds	Cole–Museum of WFB
WFB 120	Biology of fish	Burke et al.–Arboretum Cole–Museum of WFB
WFB 120L	Biology of fish laboratory	Cole–Museum of WFB
WFB 121	Physiology of fishes	Cole–Museum of WFB
WFB 130	Physiological ecology of wildlife	Cole–Museum of WFB
WFB 131	Biology & management of Cervidae	Cole–Museum of WFB
WFB 136	Ecology of waterfowl & game birds	Cole–Museum of WFB
WFB 140	Ecology & evolution of vertebrate social organization	Cole–Museum of WFB
WFB 151	Wildlife ecology	Cole–Museum of WFB
WFB 153	Wildlife ecotoxicology	Cole–Museum of WFB
WFB 154	Conservation biology	Cole–Museum of WFB
WFB 191	Museum science	Cole–Museum of WFB
WSC 110	Irrigation principles & practices	Burke et al.–Arboretum
WSC 122	Biology of running waters	Burke et al.–Arboretum
ZOO 134	Herpetology	Shaffer–Amphibians & reptiles Shaffer–Zoology collection
ZOO 136	Mammology	Shaffer–Zoology collection
ZOO 136L	Mammology laboratory	Shaffer–Zoology collection
ZOO 137	Ornithology	Shaffer–Zoology collection
ZOO 137L	Ornithology laboratory	Shaffer–Zoology collection